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RADIO NEWS

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JULY
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BROADCAST WRNY STATION

Edited by HUGO GERNSBACK

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

New Tubes---

the perfect tonic for your radio

Is your set "run down" after long, constant use? The finest radio tonic known is to install a correct, new tube in every socket of your set.

One inferior or old tube may be crippling your set and causing poor reception.

Have your dealer test your tubes and install new, wide-awake Cunningham Radio Tubes to replace the old ones.

E. T. CUNNINGHAM, INC.

NEW YORK CHICAGO SAN FRANCISCO

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Cunningham RADIO TUBES

CASH IN ON RADIO Now
ACT AS A RADIO DOCTOR
HELP YOUR DEALER
BUILD SETS FOR YOUR NEIGHBORS
EARN $75.00 a Week in your spare time

Follow the Example of Thousands—Join the Radio Association—Learn Radio—Take Advantage of its Big-Pay Opportunities

THE RADIO ASSOCIATION OF AMERICA will help you make money in Radio, full or part-time. It will teach you how to build and repair sets; start you in business, if you wish.

Earned $500 in Spare Hours

Hundreds of members earn $3 an hour serving their communities as "radio doctors." Member Lyle Follick, Lansing, Michigan, has already made $500 in his spare time. Member Werner Eichler, Rochester, N. Y., is earning $50 a week. Member F. J. Buckley, Sedalia, Mo., is earning as much money in his spare time as he receives from his employer.

The Association will train you to be a "radio doctor" and to build sets "tailored" to your neighborhood needs, that you can sell for less than the "ready-made" sets offered by your local dealers.

We Will Start You in Business

If you prefer a business of your own to becoming a Radio Engineer, our co-operative plan will start you in a business of your own without capital.

This plan gives the ambitious man his opportunity to establish himself in his community.

Many have followed this plan and established radio stores.

Doubled His Income in Two Months

Member W. E. Thom, Chicago, was a clerk in a hardware store when he joined the Association. The training we gave him enabled him to secure the managership of the Radio Department of a large store at a 220% increased salary.

"I attribute my success entirely to the Radio Association," he writes. "Your method of instruction is wonderful."

Membership in the Association has increased the salaries of innumerable men. Some turned their extra hours into cash, being "radio doctors" for their neighbors; others by accepting employment with neighborhood radio dealers. Scores of our members are now connected with big radio organizations in different capacities. Others are proprietors of prosperous stores.

From Clerk to Owner

"In 1922 I was a clerk," writes Member K. O. Benzing, McGregor, Ia., "when I enrolled. Since then I have built hundreds of sets—from 1-tube Regenerative to Superheterodynes.

"I am now operating my own store and my income is 400% greater than when I joined the Association. My entire success is due to the splendid help you have given me."

Membership Privileges

If interested in Radio as a profession or a profitable hobby, join the Association. You will receive a comprehensive and practical training in Radio that will fit you for Radio's big-pay opportunities.

You will have the benefit of proven business-building plans. Our Employment Service will be at your disposal. You will have the privilege of buying radio parts at wholesale. You will have the Association behind you in carrying out your ambitions.

ACT NOW—If You Want the No-Cost Membership Plan

Now is the time for you to join. The success of the Association was so tremendous during 1927 that we are still able to offer a limited number of Memberships that may not—need not—cost you a cent. To secure one of them, write today without fail. We will send you details, and also our book, "Your Opportunity in the Radio Industry," that will open your eyes to the possibilities in Radio for you. Let us hear from you at once.

RADIO ASSOCIATION OF AMERICA
4513 Ravenswood Avenue
Chicago, Ill. Dept. RN-7

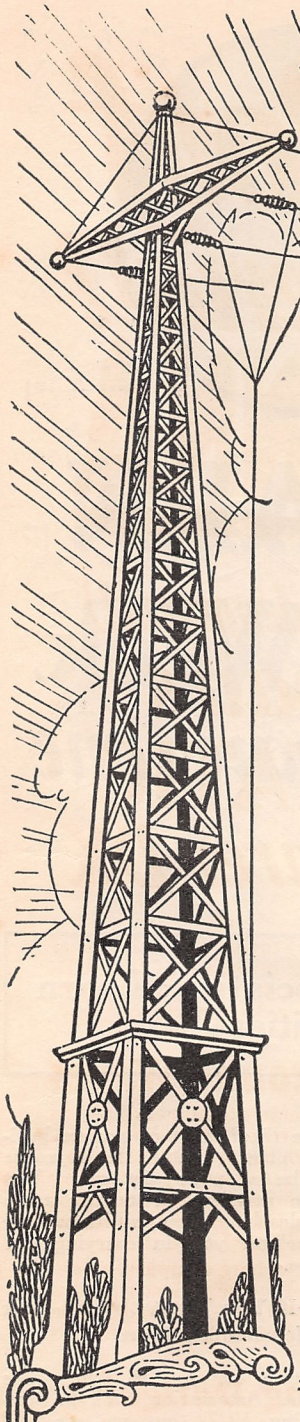
Gentlemen:

Please send me by return mail full details of your Special Membership Plan, and also a copy of your book, "Your Opportunity in the Radio Industry."

Name.....

Address.....

City.....State.....



RADIO NEWS

Volume 10 JULY, 1928 Number 1

Contents of This Issue

"Radio Concerts" By Hugo Gernsback 7

"Sure, Them Was the Happy Days" (?) By Charles Magee Adams 8

Radio Behind Prison Walls By Ollie Meloay, No. 52607 10

Radio Aids Marine Fire Fighters 12

The Passing of the Third-Floor Quack By Robert Francis Smith 14

How Many Stations on One Wavelength? (Part II) By J. H. Barron, Jr. 16

Radio Programs to Suit the Thermometer By Julia V. Shawell 17

The Listener Speaks By Himself 18

Broadcastatics 19

Television—Practical Demonstrations Over WRNY By Theodore H. Nakken 20

Vacuum Cameras to Speed Up Television By R. P. Clarkson 22

Radio Aerials By Fred H. Canfield 24

List of Broadcast Station Calls 28

How the Radio Public is Being Fooled 29

Radio Aerials Create No Lightning Hazard By Baron Manfred von Ardenne 30

What is the Life of a Fixed Condenser? 32

The Radio Beginner—A Cheap, Practicable Receiver—The Crystal Set 33

A "Junk Box" Short-Wave Receiver By Robert Hertzberg 36

A.C. Tubes Require Special Wiring Care 39

A Sturdy and Dependable "B" Power Unit 40

Improving Reception on a Thin Pocketbook By Luther C. Dilatush 44

Radio News Monthly Prize for Constructors—An Announcement 46

Radio Wrinkles 47

A Simple Remote-Control Device By William F. Crosby 48

Interstage Coupling for Screen-Grid Tubes By E. H. Rietzke and N. M. Cooke 50

Methods of Obtaining Suitable Screen-Grid Voltage By H. A. Pelton 51

Letters from Home Radio Constructors 52

Radiotics 54

I Want to Know By C. W. Palmer 55

Radio News Laboratories 58

On the Short Waves 59

Experiments with a Double-Ground System By W. H. Griffith, M.D. 74

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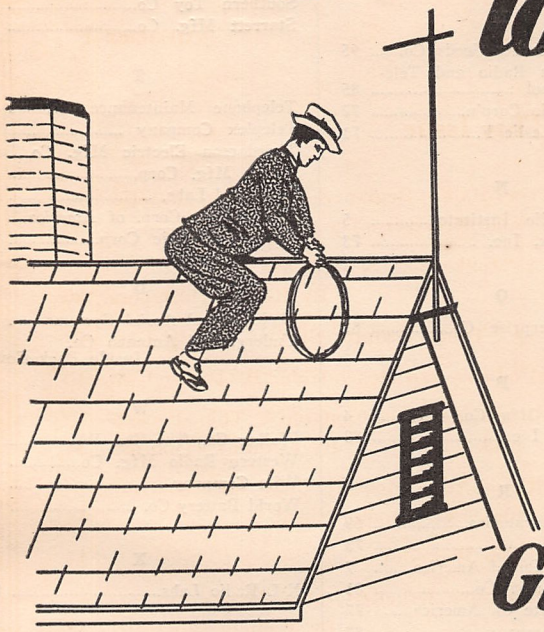
Why "Ride" the Roof to put up an Aerial?



SUBANTENNA

(Installed Underground)

Needs No Repairs

REDUCES STATIC

Gives Louder, Clearer DX

No need to climb that roof again—except to *take down* the aerial that disfigures your home. The amazing invention of the SUBANTENNA puts that clutter of sticks and wires in the discard. Risk and annoyance saved—and a better, louder, clearer tone. Static reduced even in mid-summer or during storms.

Uses STATIC-FREE Ground Waves

The secret of the wonderful volume and clarity of tones obtained with *Subantenna* lies in the fact that *it is installed underground.* The same broadcast waves travel through the ground as through the air but contain less static and are affected less by disturbing noises. Subantenna receives these ground waves and transmits every note pure and audible. Even sounds from far distant stations seem as clear as those from locals heard over the aerial.

Thousands of tests made by users everywhere comparing Subantenna with the aerial have established the superiority of this amazing underground device beyond question—and on our free trial offer, you can have the privilege of making your own test on your own set at our risk.

Removes Lightning Danger

Subantenna not only gives better selectivity and stronger tones, but safety from accidents possible on a steep or slippery roof and from lightning. An aerial can carry a lightning bolt into the house. With the *Subantenna*, the current would go into the ground.

Use It With Any Type of Set

No matter what type or make of set you have, *Subantenna* will work perfectly with it. And it takes only about 5 minutes to install it. Then your aerial troubles and your roof climbing are over, for *Subantenna*, sealed in a permanent container, needs no attention, no repairs.

Proof from Users

"I tune in WEAF with Subantenna and actually have to turn down my volume control almost to a quarter away from "OFF." When I switch to the aerial, I can hear scarcely a sound."
N. C. S., New Jersey.

"Static has been *entirely eliminated* so far as I am able to observe. For clarity and for selectivity the Subantenna is the best device I have ever had any experience with." R. L. P., Illinois.

"Last evening I got station KFI at Los Angeles which came loud and clear on the Subantenna. Changed to outdoor aerial and could not get this station at all."
H. R. T., New York.

"Am located on car line with 3 transformers across street and high power wires nearby. Aerial brings in distance with continuous roar. Subantenna gets Los Angelos and Charlotte, N. C.—practically coast to coast selectivity. Clear bell-like tones." W. J. P., Texas.

Installed in 5 Minutes

Free Trial Offer

Try Subantenna at our risk. Install it and make comparison with aerial by switching from one to the other. Do this under the most trying conditions. If you don't find that Subantenna gives greater distance, volume, loudness and clarity the test is free. Obtain a *Subantenna* from your dealer, or send the coupon for complete scientific explanation of *Subantenna* and particulars of our Free Trial Offer.

Cloverleaf Mfg. Company
2714P Canal Street • • • Chicago, Illinois

MAIL THIS COUPON TODAY

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Tell me all about SUBANTENNA, your unqualified guarantee and FREE TRIAL OFFER.

Name.....

Address.....

.....

INDEX TO ADVERTISERS

Page

A

Abox Company, The.....Back Cover
Accusti-Cone, Inc. 86
Acme Wire Company..... 89
Aero Products, Inc..... 89
Aerovox Wireless Corp..... 86
All Radio Co..... 83
Aluminum Company of America 63
American Mechanical Labs..... 79
American Sales Company..... 88
American Transformer Co..... 93
Amrad Corporation, The..... 87
Arcturus Radio Co..... 91

B

Barawik Co., The.....78-93-95
Bureau of Inventive Science..... 72

C

C. E. Mfg. Co., Inc..... 75
Carborundum Company, The..... 71
Carls, M. J..... 86
Carter Radio Co..... 78
Central Radio Labs..... 85
Chemical Institute of New York, Inc. 67
Chicago Radio Apparatus Co..... 69
Cloverleaf Mfg. Co..... 3
Consrad Co., Inc., The 64-70-74-80-88
Consumers Radio Co..... 72
Craftsman Radio Products..... 89
Cunningham, Inc., E. T. Inside Front Cover
Curtan Mfg. Co..... 6

Page

D

Deutschmann Co., Tobe..... 83

E

Elba Products Mfg. Co..... 83
Electrad, Inc. 81
Electric Specialty Co..... 73
Electro-Chemical Company of America 83
Excello Products Corp..... 95

F

Fanspeaker Radio Co..... 73
Fansteel Products, Inc..... 79
Formica Insulation Co..... 79
Fort Shelby Hotel 78
Freshman Co., Inc., Chas..... 71

G

General Radio Co..... 71
Gernsback, S. 76

H

Hammarlund Mfg. Co..... 81
Hamilton-Carr Radio Corp..... 79

I

Illinois Transformer Co..... 85
Independent Electric Works..... 79

J

J.M.P. Mfg. Co. 72

Page

L

Lacey & Lacey..... 71
Leutz, Inc., C. R..... 96

M

M. & H. Sporting Goods Co..... 95
Massachusetts Radio and Telegraph School 85
Midwest Radio Corp'n..... 72
Muter Co., Leslie F..... 71

N

National Radio Institute..... 5
Norden-Hauck, Inc. 73

O

Outdoor Enterprise Co..... 81

P

Pilot Electric Mfg. Co., Inc..... 4
Press Guild, Inc..... 82

R

R. E. L. Laboratories..... 69
Radiall Co. 73
Radio Association of America..... 7
Radio Equipment Co..... 81
Radio Insttitute of America..... 77
Radio Map Company 87
Radio Specialty Co..... 65
Raytheon Mfg. Company..... 83

Page

S

Scott Transformer Co..... 71
See Jay Battery Co..... 85
Smith, B. Hawley..... 73
Southern Toy Co..... 95
Starrett Mfg. Co..... 95

T

Telephone Maintenance Co..... 72
Teleplex Company 85
Thordarson Electric Mfg. Co..... 61
Tower Mfg. Corp..... 87
Townsend Labs. 71
Transformer Corp. of America..... 72
Tyrman Electric Corp..... 93

U

Underground Aerial Systems..... 69
Underground Antenna Co. Inside Back Cover

W

Walker Co., The Geo. W..... 72
Western Radio Mfg. Co..... 72
Wirt Company 87
World Battery Co. 78

X

X-L Radio Labs..... 87

Y

Yaxley Mfg. Co..... 93

PILOT brings the latest in RADIO within the reach of all!

PILOT'S "FLYING LAB"

Equipped with Pilot Short-Wave Radio Apparatus, the Pilot Airplane Radio Laboratory will be the first airplane radio station to communicate with amateur experimenters. This is the Pilot Company's contribution to the development of a communication system which promises to be a great aid to the safety of air travel, enabling pilots to receive weather reports, fog and storm warnings while flying.

A RESEARCH laboratory surpassed by few, manned by engineers who've grown up in radio, backed by a factory with unexcelled mechanical equipment—these are a few of the reasons for Pilot quality, Pilot precision and Pilot engineering leadership.

Volume production permits manufacturing economies which are reflected in the popular prices of all Pilot Radio Parts.

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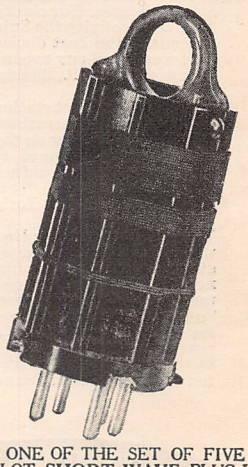

ONE OF THE SET OF FIVE PILOT SHORT WAVE PLUG-INS

RADIO'S BIGGEST 25¢ VALUE!

"RADIO DESIGN," a Quarterly Magazine edited by M. B. Sleeper, national radio authority, is brimming over with the newest and latest Short Wave, A. C. Data, Power Amplification, latest Television Development, etc. Send 25c. stamps or coin for four meaty quarterly issues.

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Address.....

PILOT RADIO PARTS ARE SOLD IN EVERY CIVILIZED COUNTRY IN THE WORLD!

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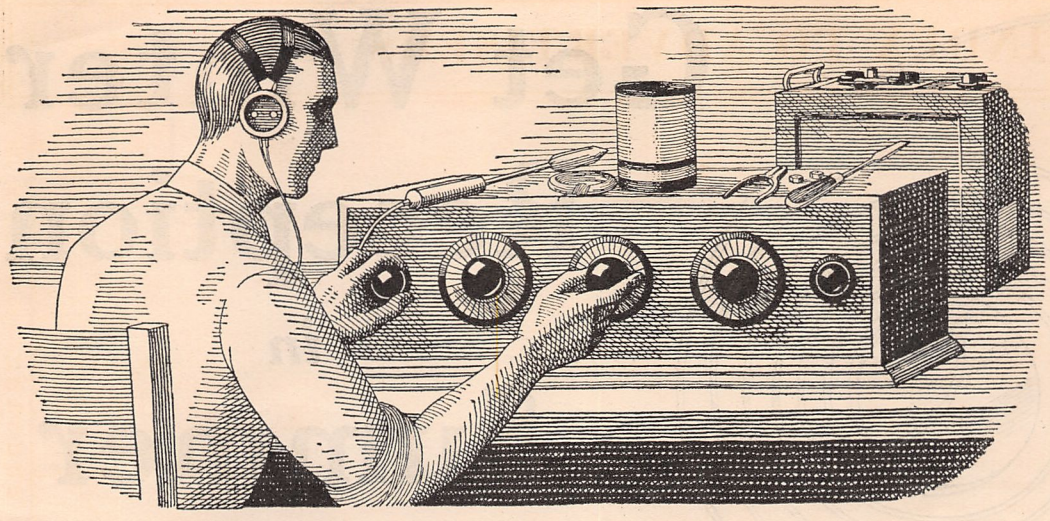


If all the Radio sets I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything —that was all I could see in it for me.

I Thought Radio Was a Plaything

But Now My Eyes Are Opened, And I'm Making Over $100 a Week!

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job—while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away! Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler —I thought Radio was a plaything. I never realized what an enormous, fast-growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field, and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation —the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President National Radio Institute, Dept 7S, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. 7S, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

Name.....

Address.....

Town.....*State*.....

Occupation.....

Get Winter Reception *in* Summer *with* *Astounding Successful* GROUND ANTENNA

Clearer Ground Wave Reception Allows Greater Distance

Hundreds of satisfied users of the sensational Ground Antenna—Aer-O-Liminator—are wondering how they ever got along without it. All over the country radio owners are finding marvelous satisfaction in freedom from static and noise interference. This revolutionary improvement of reception comes from hooking your receiver to Ground Wave Reception. Radio engineers tell you that the broadcast wave through the ground is in most cases almost static-free, and with rare exception carries no noise interference.

Read Proof!

"I have tested and thoroughly approve the Aer-O-Liminator. I find it increases selectivity and volume without distortion, practically eliminates static, gives good, clear tones, both on local and distant stations.

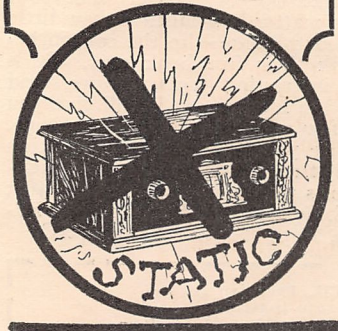
I would recommend the use of Aer-O-Liminator to every radio owner to get the best reception from his set."

JOHN E. CHRISTENSEN
(Radio Engineer.)

* * * *

"There's no such thing as static trouble since I got my Aer-O-Liminator. I get stations I never got before—so loud and clear I would almost swear they were in the next room."

R. CURTIS,
Illinois.

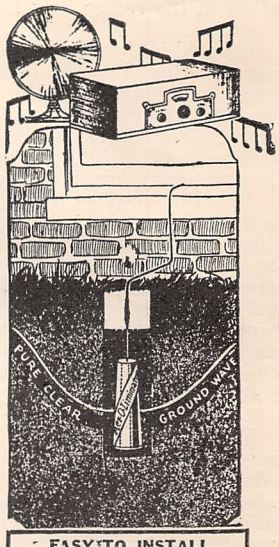


Natural Tone—Better Selectivity

The rapidly increasing army of Aer-O-Liminator owners also enjoy and appreciate the natural human tone and clarity of this Ground Wave Reception. If you haven't tried it you can't imagine the difference!

Another advantage users have found with Aer-O-Liminator is the surprising DX they get. Distant stations formerly drowned out by static or noise interference of air waves now come in clear as a bell. Selectivity is improved because, with pure, clear Ground Wave Reception, you can pick up and log signals that before were lost in the jumble of shrieks and howls so common in DX reception through air waves.

You shouldn't deprive yourself of the new thrill of pure, clear ground wave reception a day longer than necessary. We let you prove it for yourself.



EASY TO INSTALL
Just dig a small hole about 6 inches in diameter and drop Aer-O-Liminator into it.

FREE TRIAL

Make This Thrilling Test At Our Risk!

Install an Aer-O-Liminator (Ground Antenna). Leave your old overhead aerial up. Try out on a night when static is bad. If you do not get a wonderful improvement in freedom from static, greater selectivity and clear, sweet tone without interfering noises, if you can't get good receptions on stations that are drowned out by static on your roof aerial, you need not pay us a red cent for this test! Send coupon at once for scientific explanation of Aer-O-Liminator (Ground Antenna), proof of performance, and our conclusive iron-bound guarantee and remarkable Free Trial Offer—Mail Coupon TODAY!

Aer-O-Liminator (Ground Antenna)

Passed by the National Board of Fire Underwriters. Meets requirements of the National Electrical Code. Endorsed by Foremost Engineers and Dealers.

CURTAN MFG. COMPANY

Dept. 827-K.A. 154 East Erie St. Chicago, Ill.

Rush This Important Coupon

CURTAN MFG. COMPANY,
154 E. Erie St., Dept. 827-K.A., Chicago, Ill.

Please send me at once complete description of Aer-O-Liminator, with details of guarantee, Scientific Proof, and Free Trial Offer.

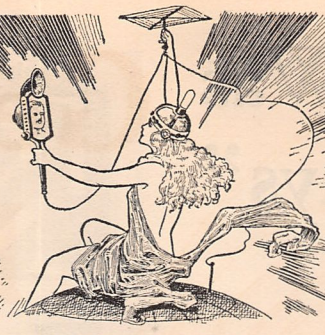
Name.. .....

Address.....

City..... .....

State..... .....

Radio News



Hugo Gernsback Editor & Publisher

Editorial and General Offices, 230 Fifth Avenue, New York

Vol. 10 JULY, 1928 No. 1

Vol. 3 SEPTEMBER, 1920 No. 3

RADIO CONCERTS

ON June 15th of this year the *Daily Mail* of London inaugurated the first "world" concert, in conjunction with the famous opera star, Madame Nellie Melba, transmitting her voice over vast distances; the music in some instances was heard over a thousand miles away from the sending station. Madame Melba was performing at Chelmsford, near London, singing into the microphone of a standard radio telephone apparatus.

There was nothing radically new employed in sending out her voice, the apparatus used being well known and similar to what has been described time and again in this publication. The voice, on the other hand, was heard over a great expanse of space wherever there was a radio receiving station within range which had suitable apparatus for the interception of the concert, which, by the way, started at seven o'clock in the evening, London time. The results left nothing to be desired. As a matter of fact, the several voices came thru excellently.

First a deep voice slowly announced the program, then came the first strains from the piano, and finally the clear voice of the noted singer. Several selections were rendered by Madame Melba, and the concert terminated with the British national anthem, "God Save the King."

At Paris, the *Societé Française Radio Electrique,* on the other hand, took elaborate precautions to receive the music in a totally unlike manner than has ever been accomplisht before. This company, with its headquarters at Levallois, near Paris, erected a special booth, where by means of elaborate tuning apparatus, as well as vacuum tubes in great profusion, Madame Melba's voice was received and demonstrated to a large audience by means of a big aluminum horn. The experiments, however, did not by any means end there. The climax came—and here is where the novelty comes in—when the Societé used a special apparatus comprised of nine vacuum tubes with which to receive the music. It is interesting to note that, altho *no antenna or even a loop antenna was used,* the music not alone was received over the distance of several hundred miles, but was actually registered upon a master phonograph disc! From this master, actual phonograph discs were afterwards made, and all of them were quite clear. Here, indeed, is a worth-while novelty! While, of course, there is nothing new about "canning" radio telegraph messages, the idea of catching the voice of a great opera singer by radio on a phonographic disc seems rather novel and presents great possibilities.

The point we want to make here is that, altho America is supposed to be a country bordering close to the radio milennium, and, altho there are practically no restrictions and the law is all with the amateurs, progress, as far as radio telephony is concerned, is negligible.

In Europe, where the restrictions are very severe, and where special authorization for such an experiment as the above-described one must be had, it seems the art is thriving even more vigorously than here, where there are no such restrictions. In other words, real enterprise, as far as radio telephony and radio concerts, etc., is concerned, is rather frail and spasmodic here. Of course, there are many radiophone sets in the United States now, and these are growing all the time, but there are very few big "stunts" that come to one's notice, as, for instance, the one of Madame Melba described above.

There is nothing that popularizes radio more than a concert by a famous singer, and it is to be hoped that our amateurs, as well as professionals, shall band together and try for some original ideas. We wish to suggest here only a few:

Why cannot someone go after the Presidential candidates and invite them to make a speech via radio thru a powerful telephone apparatus in the near future? With proper advertising and with the proper enterprise behind such a scheme, it certainly should not cost a great deal to do. The people of the United States, thru the amateurs, would get a chance to listen to our candidates in a very novel manner. Another idea, which, of course, is not new, would be to transmit band concerts from famous bandmasters broadcast. Such concerts could be sent from some of the big centers, such as New York, Chicago, or perhaps Atlantic City, or some other points where the bands are staying at the time.

Of course, there are countless schemes and ideas of a similar nature, all of which make it possible to popularize radio, and that is what we are after. Now, why don't we get together and do it?

H. GERNSBACK.

THE above editorial appeared eight years ago in RADIO NEWS. There was, of course, at that time no broadcasting as we know it today. It is believed that this was the first time the proposal was made to broadcast speeches of Presidential candidates. An old reader who recalled the editorial urged us to reprint it; to which request we accede herewith. After eight years, the old editorial certainly makes curious reading.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (326 meters) and 2XAL (30.91 meters) on various radio and scientific subjects.

"Sure, Them Was the Happy Days"

A Gentle Debunking of the Yarns Which Old-Timers Tell About an Imaginary Golden Age of Radio

By Charles Magee Adams

This reproduction of the cover of the first number of Radio News *shows how most radio fans of the early days did their listening: with telephone receivers on their heads and upheld hands requesting silence. The receiving set shown consists of a loose-coupler, with tapped primary and secondary, two variable condensers and one vacuum tube.*

WHENEVER old-time fans foregather to swap DX yarns, argue over the new circuits, or do any of the other things fans find so supremely worth while, the talk scarcely gets well under way before some graybeard interrupts the proceedings to unburden himself about as follows:

"But listen—" belligerently—"you've got to remember reception's nothing like it used to be. Why, back in the old days when I was still using a one-tube blooper"—edging forward on his chair—"I used to get the West coast regular. KFI, KHJ, KPO, all of 'em—I could sit down any old night and bring 'em in, and I mean right, too. You know I'm not lying. The rest of you used to do the same thing. And what do we get now?" registering disgust.

"Why, with that new seven-tube job, that's as slick as anything I ever had my hands on, I've got KFI just once!"—registering greater disgust— "And I don't have to tell you why. It's super-power. It may be all right for these program hounds; but if you want real reception I say they oughtn't to let any station use more than a thousand watts. That's all any of 'em had in the old days, and all of you know how much better reception was then."

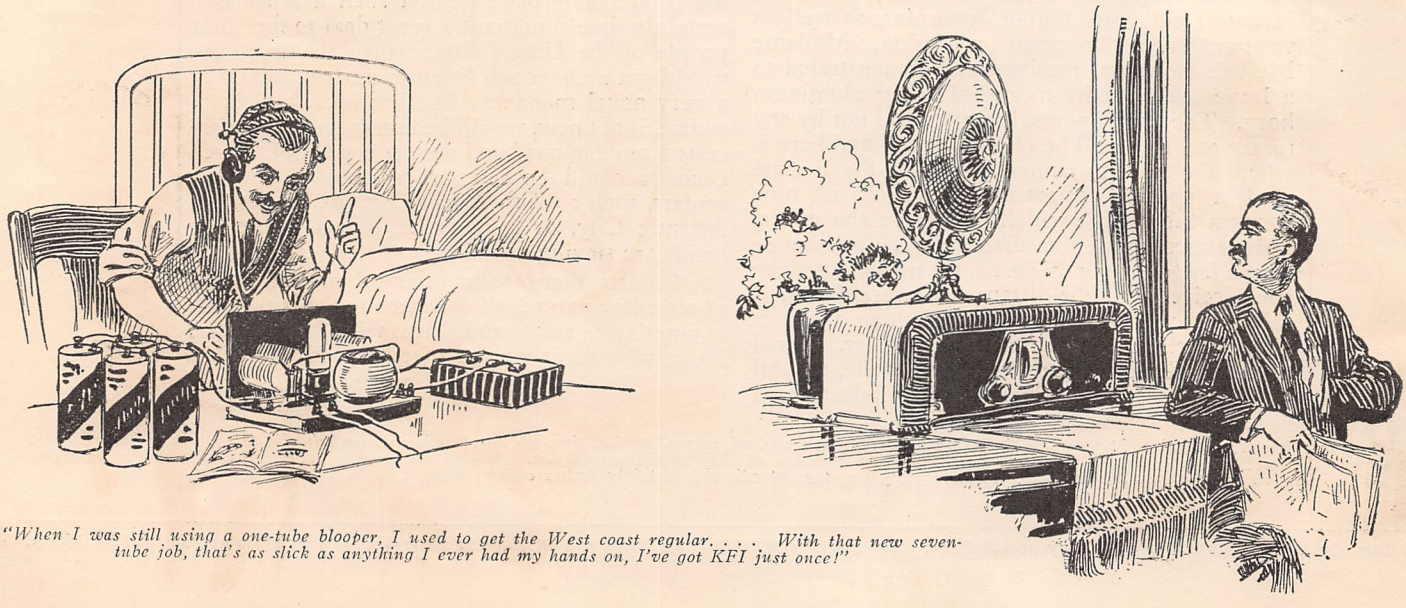
Fired by this keynote speech, the convention forthwith launches into rosy reminiscences of the splendid past and scathing denunciation of the present; adjourning only when the assembled delegates resolve to go home and once more write Washington, demanding a return of radio's golden age.

How much of all this is traceable to the mellowing mirage of memory, and how much to fact? The answer is about fifty-fifty.

GOOD "FORGETTORIES"

Through a psychological law that makes sanity possible for most of us, the mind has the trick of keeping pleasant experiences in the foreground of memory and relegating the unpleasant to the background, when they do not fade out altogether. For this reason—and with all due respect to their vehement statements—the old-timers tend to remember only the good reception of radio's happy days, and to forget the reception that was indifferent or worse. Reference to accurate logs would demonstrate that bringing in the West coast was nowhere near as regular a feat, four or five years ago, as some would have us believe, and also the stations were nowheres near as good when received—of which more presently. This much for the tricks memory plays on the "detector grid" of the mind.

As to the facts, it is true that reception "ain't what it used to be," but—and here



"When I was still using a one-tube blooper, I used to get the West coast regular. . . . With that new seven-tube job, that's as slick as anything I ever had my hands on, I've got KFI just once!"

s the detail generally overlooked in the old-timers' conventions—for reasons as much apparent as actual. First, regarding the actual.

The writer (who is an old-timer himself, and therefore sympathizes fully with fellow members of the great fraternity in the evil days which have descended upon them) used to bring in KHJ and KPO (then 500-watters, and 2,200 miles away) back in '23 with reasonable regularity, using a single-tube blooper of very dubious vintage, with only a lamp-socket aerial. In contrast to that, during the past winter, using a modern six-tube receiver, he has been able to ensnare KFI—now a 5,000-watter—only infrequently from southern Ohio, and rarely with what could be called real volume. But unlike many brother fans, he does not charge this lamentable reversal of form solely to super-power; instead, he takes account of a *marked change in the physical conditions affecting reception* which has come about during the last five years.

OLD SOL, THE CRIMINAL

It has been established, by no less authorities than the Bureau of Standards' physicists, that sunspot activity exerts an adverse influence on radio reception of primary importance. (See also the leading editorial in Radio News, June, 1926 issue, "Summer Radio Reception" on the same subject, and that of Science and Invention for August, 1926, "Sun Spots and Radio") Studies have shown that during '22 and '23—the happy days to which old-timers refer so wistfully—*sunspot activity was at a minimum, while today it is at a maximum.* The eruptions on the sun's surface, it has also been shown, occur in cycles of 11 years, which will bring another period of "optimum" (best) conditions in 1933. So it develops that Old Sol is the real master criminal responsible for the present poor DX.

This, however, does not mean that super-power wins a complete acquittal. Notwithstanding the statements of some broadcast engineers, most fans know from bitter experience that, save with receivers of razor-edge selectivity (many of which slice off the sidebands) a 5,000- or 50,000-watt station spreads more than a 500- or 1,000-watt transmitter. Given wide separation, both geographical and in the frequency band, this spreading could be minimized. But such a separation has not been incorporated in the present allocation setup; with the result that many DX stations for which fans shoot are blanketed out of audibility by other stations 10 or 20 k. c. away.

This for the physical factors involved. Now to return to the psychological.

ANYTHING WAS GOOD ENOUGH

Even the incurable old-timers must realize that a standard of reception is demanded, today, many times higher than four or five years ago. Back in the "good old days" getting a station meant simply being able to pick out its call letters. If static or interference from another station made it necessary to wait through four or five announcements before even that could be done, and the volume was so feeble that the listener had to thrust his head into the loud-speaker horn, that made no difference. Little was expected of radio then. But these days listeners have been educated to demand that the West coast come in as clearly and cleanly as a station 500 miles away; with the result that they grumble loudly when it does not.

This is particularly true on the score of volume. When a three-tube blooper was an aristocrat among receivers, bare audibility was all anyone asked of DX. But in these days of six-or-more-tube sets, incorporating power amplification at the audio end, the fan does not consider that he has really "got" a station unless it roars in loud enough for his neighbors, too, to hear. The psychological result is that he has lost his fine acuteness of hearing for weak signals. Accustomed regularly to volume that fills the house, he misses the feeble call letters that barely override the noise background, when five years ago he had trained his hearing to such a fitness that he could have picked them out with no difficulty.

HEADPHONES VS. LOUD SPEAKERS

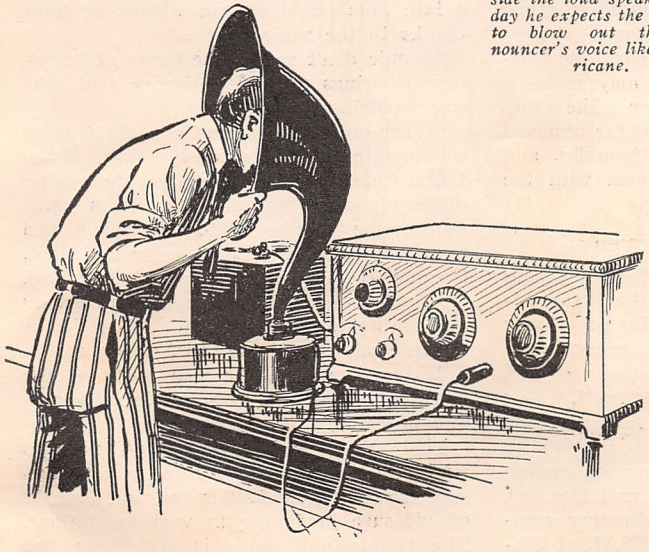
But the most important point in this whole jeremiad about poor reception is the issue between headphones (not "earphones", for the love of microfarad!) and loud speakers.

Whenever a disgruntled old-timer recounts his past achievements in getting the coast with one or two tubes, it will be noted that he used phones, and, even when he used as many as four or five tubes, cross-examination will divulge the fact that he generally plugged in the headset for DX. These days scarcely one receiver in a hundred is equipped with a phone jack, and therein lies much of the prevailing grief about the absence of DX.

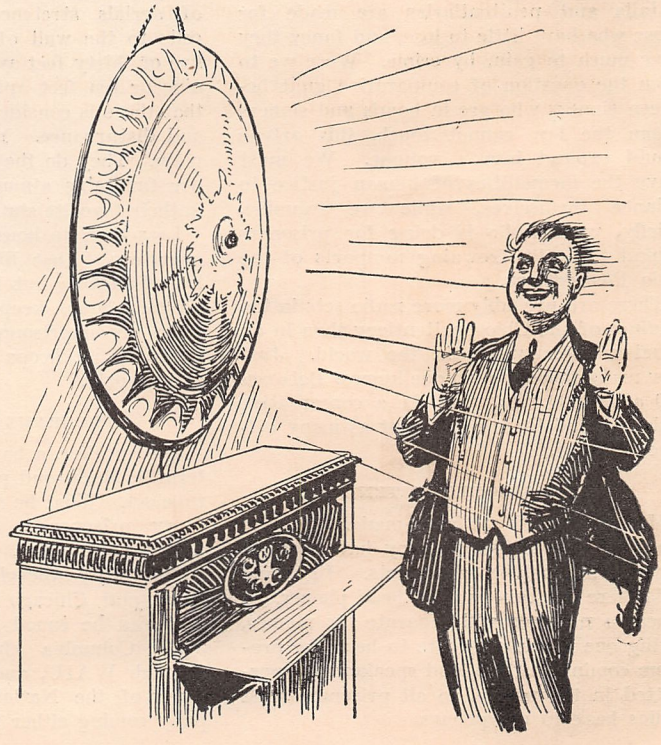
With all due respect to the many fine loud speakers on the market, it is no secret that the best of them are nowheres near as sensitive, to feeble signals, as an average pair of headphones. They simply cannot be so, yet handle the large volume they are called upon to deliver during normal operation. So a signal which would be audible with phones on the detector or first audio, just *cannot* be amplified sufficiently, even by high-power boosting stages, to the point where it will actuate a loud speaker designed first of all to deliver large volume of good quality. If the apostles of gloom who complain so loudly of poor DX would go back to phones, they would make the disconcerting discovery that, barring the interference mentioned, distance reception is much better than four or five years ago; for the very reason that transmitter power has been increased to the point where it can now overcome normal static.

So it turns out that neither is the dismal present of DX reception as dismal nor the golden past as golden as some of the old-timers would have us believe; and, in particular, that super-power is far from the double-dyed villain of the piece.

Not that all this is anything new, of course. 'Twas ever thus, long before the first disaster of 90 volts across a filament. With chronic discontent, man has ever turned his eyes to the past and said, "Them was the happy days." Ofttimes they were, to be sure. But in the case of DX as she is received today, an examination of the facts reveals rather a different story.



A few years ago a man was satisfied if he could get a station's call-letters by sticking his head inside the loud speaker. Today he expects the speaker to blow out the announcer's voice like a hurricane.



Radio Behind Prison Walls

How Broadcasting Has Benefited the Inmates of the Ohio State Penitentiary

by Ollie Meloay

No. 52607

THE greatest step for the betterment of conditions in our American prisons is directly due to the influence of radio. Radio has done more to enlighten, instruct, and create a desire, in the prisoner, to return to respectability than all the legislation our assemblies can write into the books with the idea of diminishing crime.

Jails and penitentiaries are made for those who have little to lose, and fancy they have much to gain, by crime. Were we to open the question of comparative guilt between sinners who are in bonds and sinners whom the law cannot touch, this article would expand into a volume. We must leave the inequalities of human justice to balance themselves, while we examine, briefly, what radio is doing for prisoners behind the cold, frowning ramparts of the Ohio Penitentiary.

There are probably more radio sets in the confines of the Ohio penitentiary than in an equal area anywhere in the world. Just how many there are, no one knows. Between 900 and 1,000 sets would be a conservative estimate, and there are almost as many different makes.

OLD-FASHIONED LISTENING

Most of the sets are home-made. Prisoners read up on radio and many have become experts in making good sets. In many cells there are two pairs of head phones. In others a prisoner will separate his phones, giving one to his cell-mate to hear the program coming in. No loud speakers are permitted in the prison, so all prisoners with radios have to use phones.

Many of these sets are so small that they can be easily placed in a cigar box. Others are placed on a small shelf or on the floor; for be it known, the small "drums" we call home are no wider than the average coal-chute.

If one were to walk through the long, cheerless corridors of the cell block, the first thing to attract the eye would be hundreds of aerials stretched from the prisoners' cells to the wall of the hall some twenty-five or thirty feet away. With short aerials, nine or ten feet apart, it is to be expected that there is considerable interference, noise and disturbance. Yet the men never complain. They do the best they can, and, under favorable atmospheric conditions, tune in their favorite stations with ease.

Less than an hour ago, I heard one prisoner say, "That little 'box' may make a lot of racket; but it helps me while away the long hours, keeps my mind far removed from my imprisonment, my troubles, and above all, it keeps me in touch with the outer world."

PROGRAMS ARE ENJOYED

The speaker, a bank robber, doing a long term, is the proud possessor of a little one-tube set. What he said goes for practically every prisoner in this and every other prison in America.

Columbus, Cleveland, Cincinnati, New York and Chicago are the favorites, for they can be tuned in with little difficulty. With Columbia chain programs coming through WAIU, and the red and blue net work of the National Broadcasting company coming either through WSAI, at Cincinnati, or WTAM, Cleveland, it is possible to hear excellent programs most of the time. A few prisoners, more fortunate than the rest, own powerful eight- and ten-tube sets, enabling them to get good programs from practically every station of importance in the country. WRNY, KFI, WJZ, KMOX, and many others are favorites that invariably come in with sufficient volume and clarity to satisfy the appetite of the most ardent radio fan.

Those whose knowledge of music had been confined to the chapel exercises and the annual minstrel shows, are now up in musical events, including classical, semi-classical, sacred and popular music. And there isn't a late tune but they can whistle or hum, thanks to the radio.

"People don't realize the hours of happiness it brings us," one prisoner said, who was repairing his set.

"When one listens-in on the radio he must concentrate his thoughts on his work. When I first came here we all dreaded the coming of the night. It was from the prison workshop or the "idle house" to supper and then to our cells to be locked in for the night. Completely shut off from the outside world. Of course we read, but orders are orders and the lights go out at 8.30. After that it was the solitude of our cells. Many nights I laid awake until the wee hours of the morning. Night was a horror then. Now it is a pleasure."

That prisoner said a "mouthful." He was right. Now prisoners return to their respective cells after supper and find a world of pleasure in tuning in various stations. The "lights out" hour is still 8.30; but

Warden Thomas still permits the men to listen in on their radios as late as they wish, providing they do not go into hysterics over some "hot mama" strutting her stuff, or shout "bravo," when some opera star hits 'steen notes above the staff.

PRISON RADIO STARS

During the past few months we have heard President Coolidge, Governor Al Smith, Col. Lindbergh, Secretary Hoover and other famous men. Still, in "this man's town," we don't all listen in. We have contributed our mite to radio. The Ohio penitentiary has done much to furnish Central Ohio radio stations with excellent talent to diversify their programs. Warden P. E. Thomas has repeatedly supplied prison talent to stations WEAO, WAIU, WLW, and others. Incidentally, the talent is on a par with that heard over leading mid-western stations. This is best evidenced by the fact, that after each program in which the prisoners appear before the microphone, hundreds of letters and gifts for the entertainers pour into the prison post office.

To be sure, some reformers started a series of howls that reverberated from one end of the state to the other, but their efforts availed them little, if anything. To illustrate just how much some of these "would-be" reformers really know about prisons and prisoners, I will relate a little incident that occurred last Sunday. We were in our cells; and a party of visitors were being escorted through one of the corridors.

"Why, officer," exclaimed one, her eyes as big as saucers, "they have aerials and radios in here!"

"Yes, ma'am," replied an "egg" on an upper tier. "An' some of us even got ears and brains!"

In our search for entertainment we have many interesting experiences. It is not unusual for a prisoner to want to hear the broadcast station from his home town, if there is one there. This was the habit of a prisoner who formerly called Chicago his home. In his younger days he was a church member of a prominent Chicago church; he sang in the choir and his sweetheart was a member of the same organization. Just about the time he was to be married something happened. He came to Ohio and again something happened. The young chap was arrested and today he is serving a "gang" of years. He always tuned in one of the Chicago stations when possible, in preference to all others. This was his habit until about a month ago, when the "something happened" again.

FROM HAPPIER DAYS

"It was Sunday, and we were listening to an evening concert," his cell buddy said. "The music was coming in fine and Jim (that isn't his name, but will do in this case) seemed to get unusual pleasure out of each musical number. He knew most of the songs and joined in singing with a voice that was better than the singer at the other end in most cases. He certainly was a sweet-voiced tenor.

"But all at once a woman began to sing 'Dream Kisses.' Jim lowered his head and started to bawl like a kid. Darned if he didn't cry for a long time, too. He shut the set off, and refused to let me operate it. I didn't know then what happened, but all night long Jim kept tossing and rolling in his bunk, and several times I heard him sob. The dame who warbled could warble some, too—don't you think she couldn't! But, heck, we have heard the same tune a hundred times, but it never affected Jim the way it did this time.

"Didn't know what the matter was until the next morning when I asked Jim what was the matter with him the night before. He finally told me that the girl who sang was an old sweetheart, and would have told me more, but he started crying again and I walked away.

"We have neither of us mentioned the matter since, but it was over a week before he would let me turn the set on again. Jim's a funny fellow that way. But he's gotten over the tune now and we enjoy the set again. But do you know he never tunes in Chicago any more?"

BACK TO DIXIE

Colored prisoners as well as others have their sets. Several negroes who migrated north when they thought they could secure work and big wages, have their sets, and invariably tune in Atlanta, Memphis, Chattanooga, Birmingham and other southern stations. Some prisoners prefer KWKH at Shreveport, La. That is the station whose owner is always in a fighting mood and ready to jump anybody, anywhere, anytime. We love a fighter and that guy Henderson is sure a champ'. Whenever we can get Shreveport, we never worry about what we are missing.

Warden Thomas does not object to the men having their radio sets. He will tell you that they improve the morale of the men. "When they are listening in on their radio sets," said the Warden, "they are not hatching plots to escape or make trouble. And the worst punishment I can inflict upon an unruly prisoner is to take away his radio set."

The boys with the radio sets are better behaved. They give better work in the shops, and in the "idlehouse," now, where hundreds of them must of necessity spend their time, they plan for the evening's entertainment, instead of brooding over their troubles or planning some kind of deviltry.

"HOME" SET BUILDERS

In the prison library, conducted by Chaplain T. O. Reed, are many books and magazines on radio, and the chaplain will tell you that they are in greater demand than any other books or magazines in the library. The men read up on radio, and when an improvement can be made by themselves to their radio set they make it.

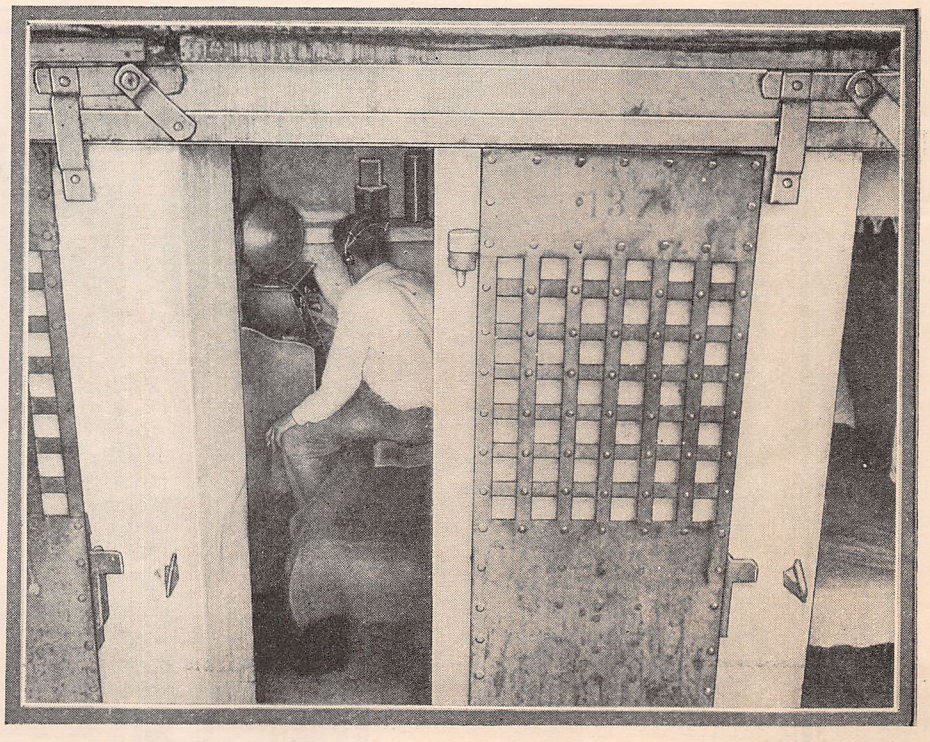
The radio programs are clipped from the radio pages of magazines and newspapers, and each man picks out his own program. A guard who went through not long ago checking up the stations that were being heard, found that more than fifty stations were tuned in at the same time in different sections of the prison.

Radio has done wonders for the men behind these massive walls of grey. It keeps them in touch with the outside world as nothing else could do. Many who are unable to read or write enjoy the programs just as much as the better-educated prisoners. Ignorance is no bar to enjoyment of radio.

Each day new sets are being added to those already owned in the Ohio penitentiary; and with each set installed there is the making of a better prisoner, a future citizen who will be an asset to the state in lieu of a liability.

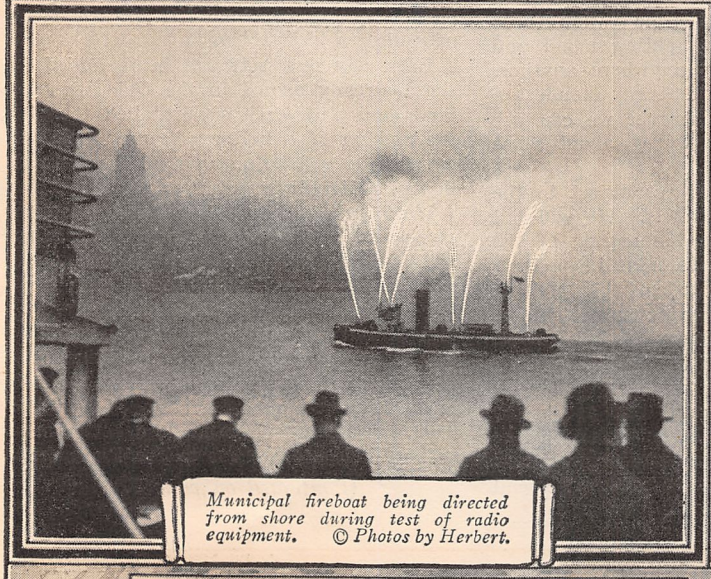
If no further benefit from radio was ever received than that which it furnishes to us unfortunate men, it is the greatest God-send in the world. Transplant a man from the outside world of hustle and strife, put him behind the cold grey walls of this or any other prison, with the association only of others who have fallen by the wayside in the busy struggle of life, and, to say the least, it does not go to make a better man of him. He soon learns to despise society,

(*Continued on page* 80)

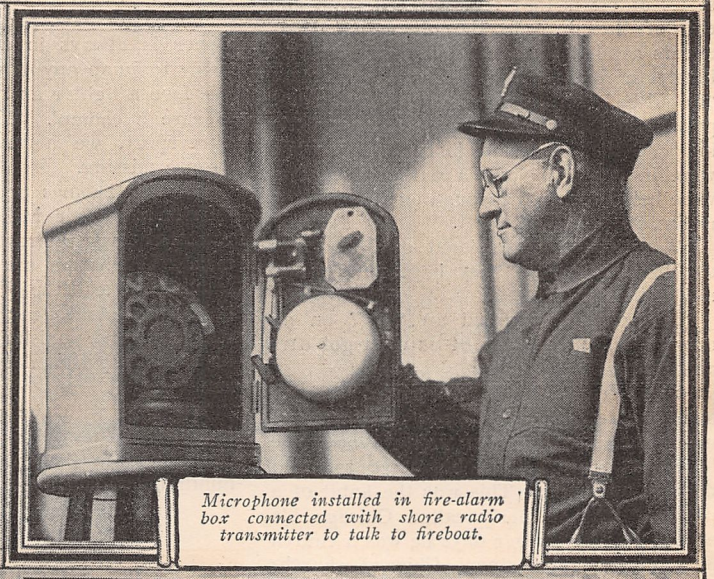


When these steel doors shut upon a prisoner, he has one tie still binding him to the remainder of humanity—the faithful, tuneful, compassionate radio.

RADIO AIDS MARINE FIRE FIGHTERS



Municipal fireboat being directed from shore during test of radio equipment. © *Photos by Herbert.*



Microphone installed in fire-alarm box connected with shore radio transmitter to talk to fireboat.

Fire-alarm box which may soon be replaced by new radio communication system.

Radio equipment installed aboard the "John Purroy Mitchell" during demonstration.

The transmitting aerial of WNYC, atop the 40-story Municipal Building, which looks down on New York's historic City Hall. The aerial has recently been rearranged, as shown here.

THE city of New York has again found that radio can be used to increase the efficiency of its departments—this time aboard the city fireboats. With a similar end in view, the Police Department recently installed an elaborate system of radio communication, including complete radio transmitting and receiving sets, on the *Macom,* the city's official welcoming boat.

In the past, one of the greatest difficulties in the handling of the fireboats has been caused by the lack of any means of communication when the boats are away from the wharf. Once beyond hailing distance of land, it has, in the past, been impossible for those directing operations to issue any further orders to the tugs until they again come near the shore or unless a special boat is used as a messenger. For example, suppose that a fireboat is near Spuyten Duyvil (at the upper end of Manhattan) and after putting out a fire there is wanted in the upper end of the East River. If the boat is on her way down the North (Hudson) River to her home station at the Battery (at the southern end of the island) she will be completely out of touch with headquarters for approximately one hour. However, with radio equipment aboard, it would be possible for her to be taken through the Harlem River almost directly to the scene of the fire, without going all around the island; thus saving about two hours, a matter of considerable importance in dealing with a fire.

A RADIO SURVEY OF THE HARBOR

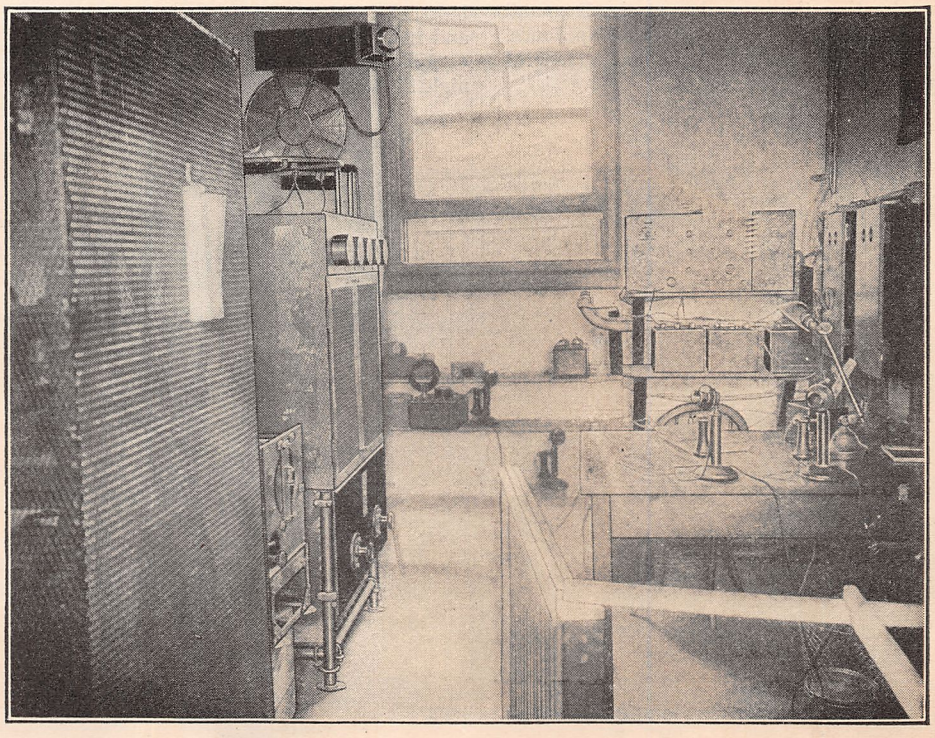
Tests recently conducted by city officials have proved that the installation of radio equipment on the city's fleet of fireboats will increase the efficiency of that branch of the service to an enormous extent. Under the new plan, fire-alarm boxes along the waterfronts will be equipped with special telephone devices which will connect, over special lines, directly to the radio transmitting and receiving equipment. This will enable the person turning in the alarm to communicate directly with the captain of the fireboat, whatever her position, and inform him of the exact location of the fire,

In preparation for the first tests, a survey of the harbor and rivers around New York was made by Isaac Brinberg, engineer in charge of WNYC, the municipal broadcast station of the city of New York, under the direction of Robert Goldman, Commissioner of Plants and Structures, in order to ascertain the *"field strength"* of a transmitter located at the Municipal Building, and to determine just what types of equipment are best suited for use both ashore and aboard the boats. During a series of three tests it was found that there are no serious "dead spots" along any of the waters surrounding the city when a wavelength of 730 meters is used; although a decided decrease in signal strength was noted whenever the boat passed under any of the bridges spanning the Harlem and East Rivers.

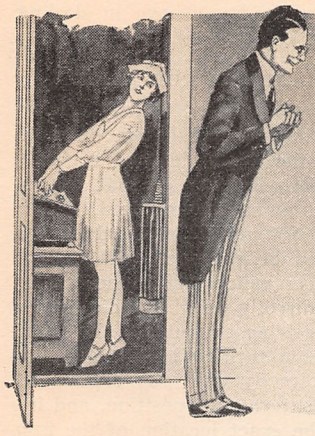
A GENUINE TEST

For the purpose of the tests, a complete 200-watt, C.W. and I.C.W., transmitter was installed aboard the fireboat *John Purroy Mitchell,* together with a sensitive vacuum-tube receiving set, while similar equipment was placed in the operating room of WNYC. The ship station was licensed under the call letters WRBE.

(*Continued on page* 73)

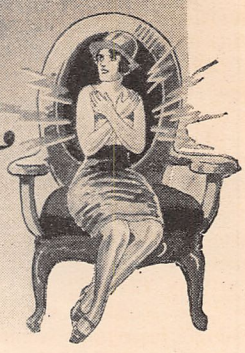


The control room and transmitter of WNYC, located on the 25th floor of the Municipal Building, where the radio telephone and telegraph tests originated. This station is owned and operated by the city of New York.



The Passing of the Third Floor Quack

By Robert Francis Smith



"I SEE," remarks Doris, peeking over the top of a copy of *Variety*, "that the Siamese Twins are entering the movies." "Yeah," I replies, "they expect to sign with United Artists."

Doris gives me the bird. "Ixne acking-cre," she advises. "Save that one for the Lambs' Gambol."

"I haven't the heart," I returns.

"Then get your circulation audited!" snaps the frau. "Come on—we're due to hoof!"

It's backstage during rehearsals of *My Radio Girl*, a hop, skip and flop fracas wherein the tenor saves the soprano from the baritone while thirty-two Rumpus Baby Stars go off to Buffalo left center. These latter are the vital element in musical comedies. As Aesop remarked, Farmer Boys belong to a Calf Club; City Boys do too, but in a different way.

Consequently there are cuties all over the places, blondes, brunettes and red-heads, all distinguished by a common complaint—hunger. Doris and I (Mr. and Mrs. Joe Hammerstein, thanks) dragged along our suitcase radio this morning, and everybody in the outfit is trying to tune in all at once.

"Listen," commands Millicent, third from the right, "cut out that hooey about bee farming and connect with the station that's broadcasting the new play at the Regent."

"What's the name of it?" asks Tap Jones.

"I don't recall—but it's about a federal agent."

"Oh, yes," drawls Tap, "I remember—'The Shepherd of the Stills.'"

"On the lam, kid!" giggles Millicent. "You're grounded and don't know it!"

Tap grins, and comes over to watch us perspire a new trick step. Somebody switches off the radio and a howl goes up. If you've never been behind the asbestos when ideas were being vented, you've never heard static in its native heath. All in all, we're having a wonderful time, when The Master blows in.

Out at Brightmere-on-the-Deep, Long Island, where the gaseous nebula and I get our mail, Jerry Lawson is our nearest neighbor and closest pal. Inquiring at his front door, the butler will doubtless tell you that "The Master is in his laboratory." For Jerry is a scientist, twenty-five, tall, dark and devoted to radio. Incidentally, he's a millionaire, which usually is more than an incident.

Most of the cast know The Master—the length of time it takes a chorus girl to try her wiles on Jerry is equal to the distance between 300 and 400 meters on the dial of a single-tube set—and he's always welcome, having recently developed a flair for artistic lighting, and liking to come around and offer advice. That's *his* story.

"Oh, hello, Jerry!" yelp about thirty bowzers, making a grand rush for the prize and bowling over a deck-hand en route.

"Whadda ya think this is—Country Store night?" demands the scene-shifter. But the girls are all about The Master.

"It's no use, kids," I calls, "Jerry's weakness is radio."

But they fusses around him until Harry squawks for an ensemble number. The Master and I parks on a trunk to watch the ankles ank. I opens the pot.

"Anything on the w.k. mind?"

"Nothing whatsoever," replies Jerry. "I've not a care in the world, just at present."

"It must be a novelty," I remarks.

"It is," agrees The Master solemnly.

The girls are lined up, two rows, ten to a set, and Harry is telling them—you need no amplification on Harry—well, spin the dial—

"Lissen, you flock of beef toters, whassa idea . . . you ain't understudying no ocean liner . . . I should provide you with tugs . . . I said bell, and I mean bell . . . *bell*, get me! No doorbell, either . . . like this . . . high . . . come on, snap into it . . . with the music . . . *with the music*! . . . now, sweet children, let us BELL—act like you saw a mouse . . . most of you dumb broads couldn't act normal . . . oh, f'Gawd's sake, Muriel, that's right, fall all over the piano, it won't mind . . . yes, you're stiff, all right, mostly in the head . . . now girls, *please* . . . pretty please . . . beautiful please . . . Elaine . . . is that your name . . . well, King Arthur wants you to bell . . . 'way up . . . all right, *all right*, whadda *you* want . . ."

Somebody tunes in a luncheon broadcast—it's noon— and runs up a few stages on the loud speaker. At the mention of food there's rapid dissension in the ranks. Harry throws up his arms in despair.

"I give up . . . finis . . . the end . . . go eat, and be hanged!"

"Pleasant fellow," says Jerry. "Why do the girls tolerate it?"

I shrugs my shoulders. "You've gotta go through static before you can get distance, haven't you? These bimbos hope to be stars some day. This is merely the listening in."

"Apparently," answers The Master.

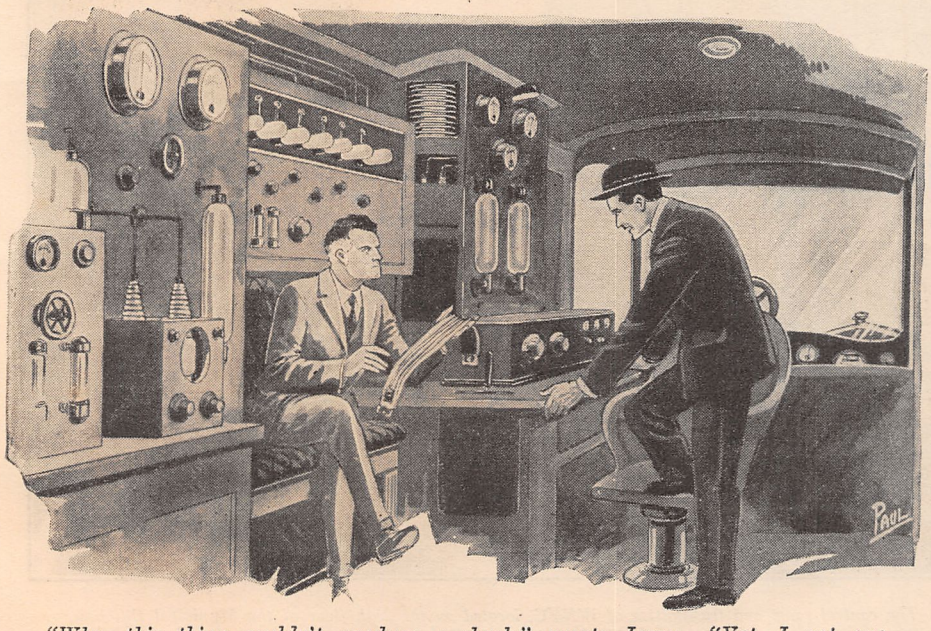
The girls are attired in practice suits, and one of them, Elaine, previously mentioned, passes us on her way to the dressing room.

Jerry stops her. "You'll pardon me," he requests, "but don't you find this work a bit strenuous?"

Elaine is one of the quieter kids—a brunette with a kitchen complex—and of course she doesn't muff a chance to get chummy with the long green.

"Oh, yes, I often tire," she answers, all eyes and figure. "But my doctor has been prescribing treatment, and I find it most effective."

"Indeed?" inquires The Master politely.



"Why, this thing couldn't produce a shock," snorts Jerry. "Yet, I got one from that chair belt!"

"Would you care to lunch with Doris, Joe and myself?"

I gives a start, and ogles Jerry. It's unusual for him to notice girls, and he did this all by himself.

"Oh, I'll be delighted!" she squeals, and runs off to make a quick change before they closes the Ritz.

"I thought you were cured," I snorts. "How come?"

The Master shakes his head. "Have no fear, Joe, I'll never fall in love again; once was entirely sufficient. This is mere curiosity."

"Why Elaine?"

"She seems a rather ingenuous young thing," he replies vaguely.

"Just a little Yellow Cab girl," I states. "Pick one up anywhere."

"Is she looking for a husband?"

"Is she—say, Elaine's just aching to take some poor goof for petter or for hearse!"

The Master lapses into a mood, and I don't destroy it until Elaine comes back, all thrills and the mark of envy by the other eye-fulls. Jerry brightens immediately, and when Doris joins us, we wanders out to tie up with a salad.

We get a booth in a quiet cafe, and the rag is forthwith masticated. This sorta leaves Elaine in the cold, being a stranger; but no chorus child ever let a chance at big money go untouched, so she casts for big fish with a play at Jerry's profession.

"Oh, are you a radio man, Mr. Lawson?" she inquires naively.

"Why, yes," replies The Master. "I am a radio engineer."

"Among other things," I puts in, "including A.B., S.B., Q.R.M., B.V.D., or what have you?"

Jerry sees it's a joke, and laughs. But Elaine sticks to her wavelength.

"My physician has been ordering radio treatments," she says. "I find them so much of a help."

"Radio treatments?" repeats The Master, surprised. "Is he broadcasting his advice?"

"No, no," explains Elaine. "I mean the radio waves—those that aren't being used by sets—to stimulate the heart."

"But I don't understand—"

Elaine is seemingly annoyed. "I thought you knew all about radio," she pouts. "I mean the Tolman Breast Belt. I'm wearing one now."

"Tolman Breast Belt?" reiterates Jerry, puzzled. "Never heard of it."

"Why, it's the greatest invention of the age!" she exclaims. "It's doing me a world of good." She fusses in her bag and produces a small folder.

The Master scans it, and then hands it to me with the office to keep mum. The front page of the brochure is enough. It states:

Are You Tired, Worn Out, at the End of Day? Lack Pep? Have No Ambition? Then Be Fitted with the Marvel of Medical Science,

DR. TOLMAN'S RADIO BREAST BELT

Immense quantities of electricity, the most vital factor in life, are constantly passing through the air since the coming of radio broadcasting. DR. TOLMAN'S RADIO BREAST BELT converts these electrical waves into UNTOLD ENERGY! SPECIALLY VALUABLE IN CASES OF CHRONIC DISEASES OF THE HEART.

Just a gorgeous fake, but I sees that Jerry's got something to think about, so I stays silent while he pumps Elaine.

"Oh, yes, indeed, I recall it," he lies beautifully. "Dr. Tolman—oh, yes, of course. How long have you been using this belt?"

"A month," replies Elaine, tickled at having got Jerry's attention. "I feel so much better—my heart beats are more even."

"When we return to the theatre, may I see the belt?" asks The Master. "I've never closely inspected one."

Elaine assents, and for the rest of the meal spouts for Jerry's benefit. At two we're back for more rehearsal.

When Elaine comes out, dressed for practice, she hands The Master her belt. It's of light leather, about four inches wide by a quarter of an inch thick, and hooks in front. There's nothing noticeable on the exterior.

"I'd like to purchase this, if I may," says Jerry. But Elaine shakes her head.

"Oh, I couldn't be without it a moment," she declares. "But, if you really need one, Dr. Tolman will fit you for twenty-five dollars."

Harry bellows for work, and we aren't excused until four-thirty. The Master's been studying the folder's claims in the meanwhile, and beckons for me to join him.

"This might be interesting," he states. "Would you care to help me follow it down?"

"Try to keep me away!" I defies. "Where's Tolman's hangout?"

Jerry reads off the address, and we glom a hack up to the joint. The neighborhood is middle-class apartments; they don't park any Rolls-Royces in front of hydrants, neither do they yell down dumb-waiters—much. An office building on a corner displays Dr. Tolman's sign from a third-floor window.

"There exists this difficulty," begins The Master, and I see the campaign is on. "My photo has been given considerable publicity of late, what with my weather control and such, and I fear that anyone as clever as Tolman must be will recognize me. Would you mind going up alone, first? I'll be here in the drug store."

Entirely logical, because Jerry's got a hefty rep in scientific circles. He instructs me as to the plot, and I goes on up.

Tolman's offices are neat, but not gaudy; they look almost honest. A nurse that should be in the Follies takes my card and

(*Continued on page* 66)

"It's a lie!" shouts the doc. "I can prove that—" "Yes?" drawls Jerry. "Will you take this test chair out to my home?"

How Many Stations on One Wavelength?

Part II, of a Discussion of the Problem of Enabling More Than One Station to Operate on the Same Wavelength and Same Program

By J. H. Barron, Jr.

IN the June issue of RADIO NEWS, *Mr. Barron discussed the practicability of "one program, one wave," which so many of our readers hail as the remedy for broadcast congestion. Below he discusses other important advantages which may well be expected from this method. The problem of synchronization, as well as program transmission is, however, one to tax the best of the engineering brains which are being applied to its solution. The amount of technical skill and calculation involved is beyond the imagination of most broadcast listeners. However, we may look with confidence for remarkable improvements in chain-broadcast technique in the next few years, just as we have seen them in the past.—EDITOR.*

ASSUMING that it were practical to broadcast a chain program on one wavelength from a large number of stations in various localities, the benefits derived by the listeners would be manifold; for those located near the broadcast stations as well as those living at remote points.

The effect of "fading," the bugbear of distant reception, would be greatly reduced. At practically any location in the United States, the waves from at least two stations broadcasting the same program may be received. It is not likely that fading would take place equally from each station at the same time. When the transmission from one was decreased in intensity, that from the other would probably be normal or stronger than usual. This would cause a stronger signal to be received at all times; the more stations within range of the receiver, the more consistent would be the reception.

Another annoyance, often caused by one station going off the air at the most interesting point of the program, would be alleviated. If the local station to which one usually listens should cease transmitting, the listener would immediately hear the transmission from other distant stations without interruption. It might be necessary for him to increase the volume slightly, by proper adjustment of the volume control, but the tuning controls would not have to be touched.

It would then be practical to mark the dials or note the adjustment of the controls for the point where each chain program is received. The point where the "Pink" chain, for instance, is tuned in could be marked or noted. The same could be done for other chains. On referring to the programs for any evening, the listener would decide which chain he wished to listen to at a certain time and set his receiver controls accordingly. It would not be necessary for him to "fish" around to see which station is coming in the best. He would leave the controls alone, after they were once adjusted, knowing that he was getting the best reception possible at all times.

RELIEVING BROADCAST CONGESTION

Placing all the stations of a certain chain on one frequency would preclude placing other stations on the same frequency at that time. Thus, the "heterodyning" and clashing of sidebands, now noted on certain frequencies and which are caused by the operation of stations on slightly-differing frequencies or with too short a geographical distance between them, would be eliminated.

Those who wanted to try for distant reception while the chain program was on, could do so, happy in their knowledge that they would tune in a station not on the chain, and not waste precious moments tuning in a station just audible, waiting breathlessly for many minutes—only to discover that this station is putting out the same program carried by the local station!

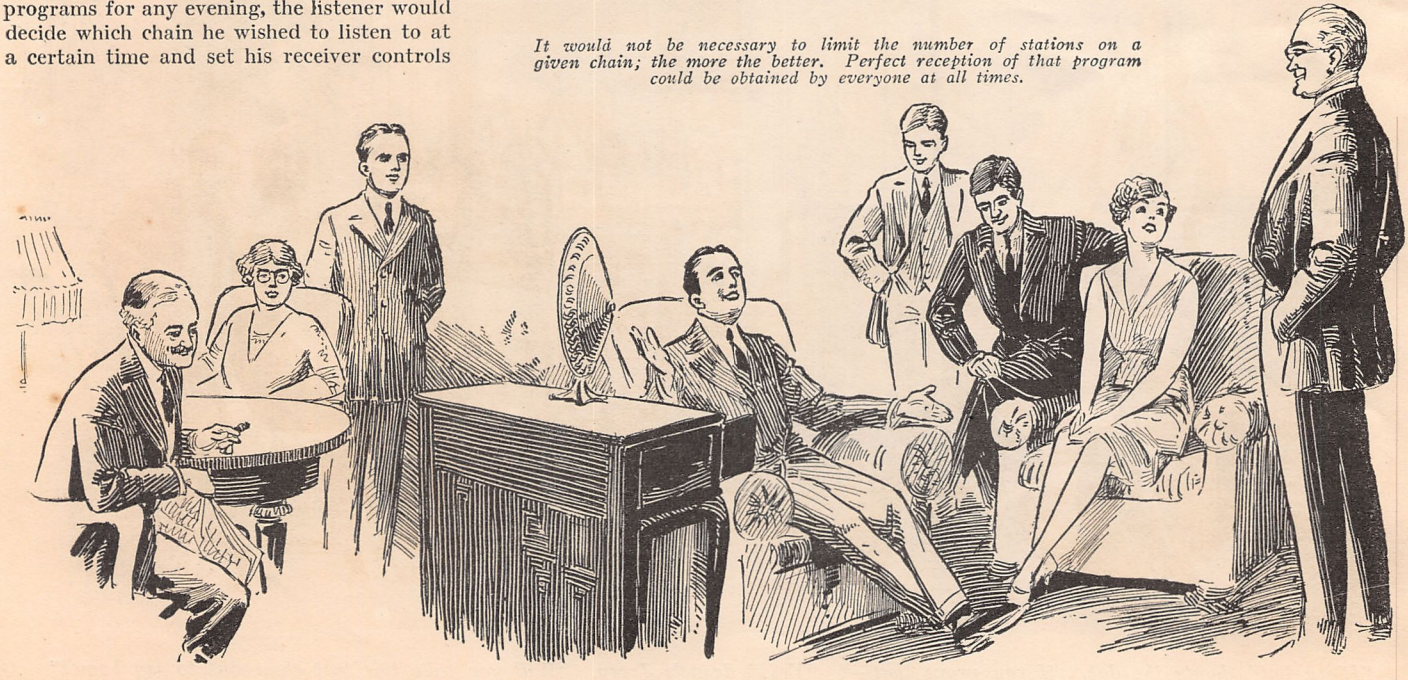
The need for super-power broadcast stations would be diminished. It would not be necessary for one station to broadcast with 50 kilowatts to reach a listener already served by the clear reception of a number of lower-powered stations. The super-power station could be changed to a 500-watt station and spare the nearby listeners from the blanketing effect of which so many complain.

If the stations on a certain chain had previously occupied fifty different channels when they broadcast on differing frequencies, and were now operated simultaneously on a single frequency, this would leave forty-nine channels for other broadcast interests to use. This would provide the listener with a great increase in the variety of programs obtainable, certainly a desirable situation.

As there are (practically) only five chains at present, widely-differing frequencies might be assigned to each and practically every listener would be able to hear each one satisfactorily. As the case is now, a local station may be broadcasting a certain chain, while the best reception of another chain is to be had from a station operating on the next adjacent channel, ten kilocycles removed from the local. Few receivers will bring in such a distant station very satisfactorily.

(*Continued on page* 72)

It would not be necessary to limit the number of stations on a given chain; the more the better. Perfect reception of that program could be obtained by everyone at all times.



Radio Programs to Suit the Thermometer

What is Being Done by Broadcasters to Dispel the Dog-Day Doldrums of the Radio Audience

By Julia V. Shawell

WHEN the thermometer rises and the last balmy breeze of late spring has given way to listless, heat-laden air, when energized activities are suspended and the whole country is engaged in the difficult task of cooling itself, radio will offer a measure of relief.

Already broadcast officials have planned their summertime programs, designed primarily to frustrate the weather man and to make millions of listeners forget their temperature discomforts. Mental suggestion, in a more comprehensive manner than was ever attempted on the ether, will be brought into use when July and August entertainment is sent out on the air waves.

Fitting the program to the calendar has become an art with those whose business it is to decide what is suitable entertainment and what is not appropriate for seasonal reception. It would be absurd to expect set owners to react favorably in torrid heat to the same entertainment which amused them while they were cosy before a December fire. And the station foolish enough to try such a futile system would find itself without listeners.

HOT-WEATHER PLANS

The National Broadcasting Company has lined up its programs primarily with the idea of holding its listeners in all sorts of weather and before the first sign of spring had come upon us was already deep in hot-weather plans.

WOR and the Columbia chain stations have decided that if their radio friends don't find solace in what they pick up on the dials, it won't be the fault of studio officials. And all the independent stations in New York, Cleveland, Detroit, Chicago and other centers of radio interest all over the continent are just as absorbed and serious in their purpose to send out entertainment which will offset some of the havoc wrought on otherwise pleasant dispositions by weather reports.

Several of the stations have already arranged to put lines into resort places where the sensitive microphone can carry the echo of the rolling waves or the suggestion of coolness by breeze-swept lakes.

Even the courageous directors of the morning "gym" classes are prepared to do their best or their worst to counteract that lazy feeling which even the early sun can create among enthusiastic adherents to the gymnastic cults.

The radio habit has been acquired by millions and even the temporary lack of any broadcast reception would be little short of a catastrophe in thousands of homes. But the habit of not listening could become just as strong as the faithful tuning-in daily. That is the reason why stations must double their efforts to insure a large audience in the months most dangerous to the industry.

Only the so-called "nuts" would be willing to swelter unnecessarily under the influence of radio entertainment just for the joy of fooling around a receiver. But every fan will turn eagerly to a station which will send out cleverly-planned numbers to make folks forget that the mercury is soaring.

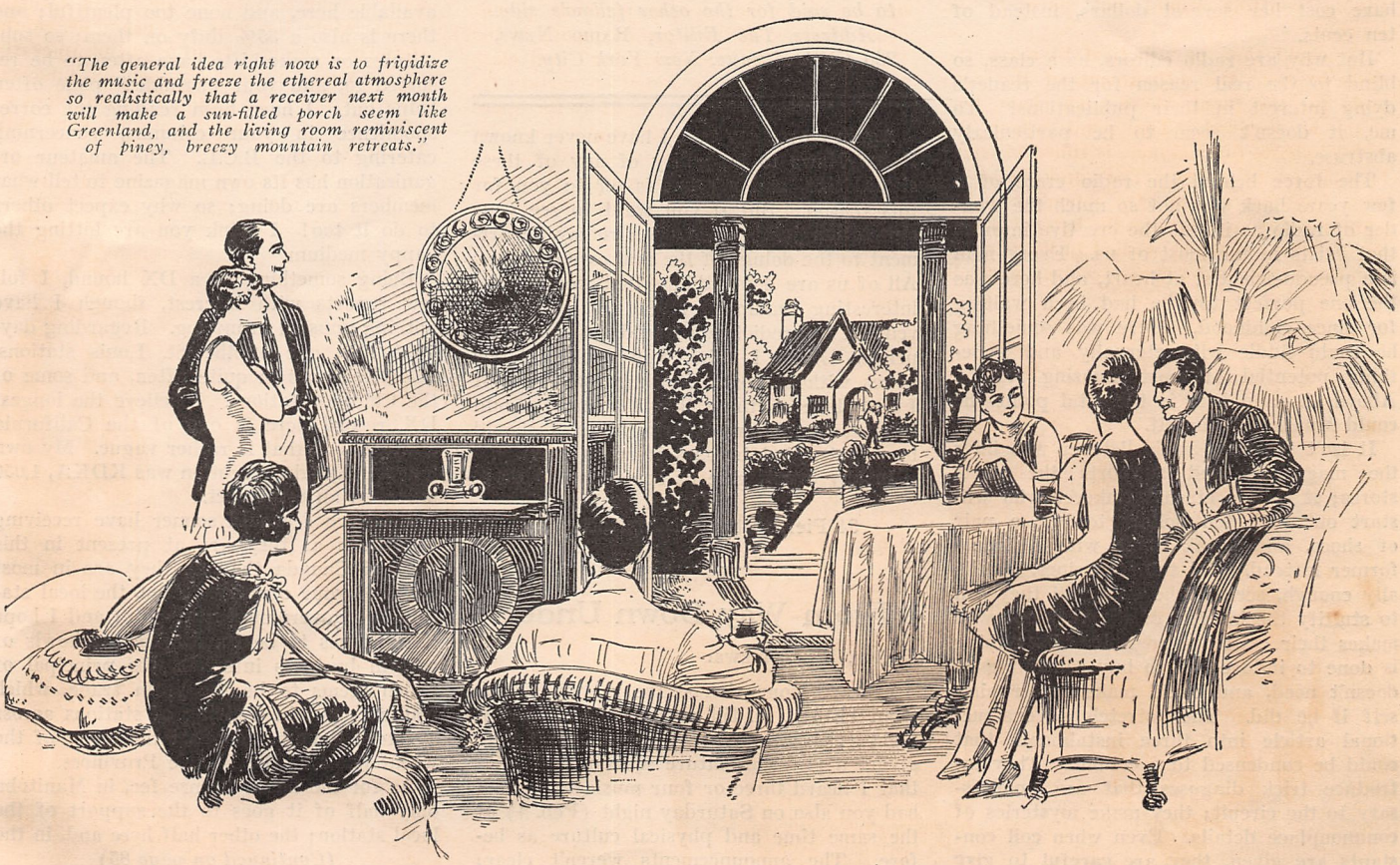
IN THE STUDIOS

Before the listeners can be convinced that radio waves can carry them refreshing material with which they may be mentally cooled and entertained, the broadcasters must so adjust their own surroundings that their artists really feel cool and refreshed. And so, already, all the ornate heavy draperies which add to the attractiveness of the metropolitan studios are in storage and the rooms have taken on their light summer trimmings. In the larger stations, cooling plants have been installed and, where this advantage is not available, electric fans play their deceptive lure on the curly locks of blonde sopranos and the placid brows of even the most ardent performers.

Do that, regardless of how unpleasant conditions may be in most city buildings, and a cool calm will prevail in the salons where ethereal music and humor originate.

(*Continued on page 70*)

"The general idea right now is to frigidize the music and freeze the ethereal atmosphere so realistically that a receiver next month will make a sun-filled porch seem like Greenland, and the living room reminiscent of piney, breezy mountain retreats."



Why There Are Radio Fans

Editor, Radio News:

May I comment on your editorial in the April issue, announcing a change in policy for Radio News, particularly as it relates to the subscriber's letter that accompanies it.

I have been in the magazine field for twenty years and know something of your problem. Also, I have been a radio experimenter since the first peep of broadcasting, and at one time devoured every magazine devoted to the subject. But, like your correspondent, I have lately become disgusted with most of them. Their constructional articles are mere write-ups for the kit manufacturers, and the rest of the space is padded with blah.

But I think he is unjust in including Radio News in this categorical denunciation. In my opinion it is the one magazine in the field to which such criticism does not apply.

The reader has a right to resent the hooking-up of articles and advertisements. But shouldn't he be shown how interrelated are his interests and those of the advertiser? A number of years ago I saw a testy old lady, who had just bought her favorite woman's magazine, vindictively rip off the advertising pages, then settle herself to enjoy the body of the magazine. She failed to realize that but for those advertising pages the literary matter would have cost her several dollars, instead of ten cents.

But why are radio editors, as a class, so blind to the real reason for the reader's dying interest in their publications? To me, it doesn't seem to be particularly abstruse.

The force behind the radio craze of a few years back was not so much the wonder of radio as it was the creative impulse that exists in the most of us. Every man is a pseudo-scientist at heart, and here was the one perfect toy he had been waiting for since childhood. Here was something he could fiddle with eternally and something potential of most amazing results. Above all—and here is the vital point—he could "make it" himself.

It isn't the mere radio listener who buys the magazines and supports the parts stores; it is this eternal tinkerer who will start out with ten dollars to buy a pair of shoes, and sneak home with a transformer instead. Yet the magazines, illogically enough, seem to be doing all they can to stultify the interest of the very one who makes their existence possible. Everything is done to induce him to buy something he doesn't need, and could make better himself if he did. They stretch a constructional article into three instalments that could be condensed to a column. They introduce trick dinguses that are unnecessary to the circuit; they make mysteries of commonplace details. Even when coil constants are given, they are careful to give them for an odd size tubing that can't be bought in the open market. I remember, for example, the hooey they broadcast regarding the very mysterious "N" coil in the Lodge circuit. And what was it? A simple solenoid that anyone could wind in ten minutes, and for as many cents.

In these days, of course, there is much that we can't do; but there is also much that we can. Any man who hasn't enough mechanical instinct to wind a better coil than most of the manufactured ones isn't safe to be trusted with a wheelbarrow. Certainly we can't get excited over kits, worthy as they may be in their place. One may as well say he makes his own clothes, since he buys them in three pieces and puts them together.

THIS page belongs to the readers of Radio News. *It is theirs for the purpose of discussing fairly and frankly the needs of broadcasting from the standpoint of the great public who listen in. The letters represent, not necessarily the editorial opinion, but that of the writers; who are, in the editorial belief, fairly typical of groups of opinion among the radio public. Make your letters concise and offer constructive criticism when you can; remembering always that there is something to be said for the other fellow's side.*

Address The Editor, Radio News, 230 *Fifth Avenue, New York City.*

Again let me say that I have never known Radio News to be guilty of any of these stupid sins, and my hat is off to you for this reason. But if you want to see your circulation jump, open up a roomy department to the doings of the real experimenter. All of us are doing things that would make interesting reading for the rest of us. I venture to predict you would get some surprises. Also, I think you could fill the pages without cost. For my own part, if I had done anything that I thought would interest my fellow experimenters, I should be mighty glad to pass it on to them.

In any event, give us something to do.

Walter de Maris,
34 Pierce Street, New Rochelle, N. Y.

From Way Down Under

Editor, Radio News:

I heard your short-wave station 2XAL from 11.15 p. m. till about 11.50 p. m. last night (Feb. 6). When I tuned in you were giving a physical-culture session, and after that I heard three or four musical items. I had you also on Saturday night (Feb. 4) at the same time and physical culture as before. The announcements weren't clear; I could only catch a word or two now and then, but I heard "WRNY" on Saturday night and also your asking for reports. Swinging and static were bad. On Monday night I heard "New York" a couple of times.

On Monday night I tuned you in after listening to 5SW broadcasting 2LO, London's midday session. It is received here very clearly as a rule and at good strength. Your station is the only American station I have heard so far, but I understand WGY is received here, sometimes at loud-speaker strength. I use a two-tube set, Mullard P. M. 3 valves, and Pilot .00015 tuning condenser.

L. S. Cuffe,
"Avalon," Constitution Road, Windsor, Brisbane, Queensland, Australia.

Gets His Money's Worth

Editor, Radio News:

I cannot sign myself a regular subscriber, but I have not missed many issues since I became interested in radio. I am just at present a B.C.L. who prefers to roll his own; but I have other ambitions, and have received much valuable help from your columns.

American-made parts are the only kind available here, and none too plentiful; and there is also a 35% duty on them; so substitutes or makeshifts have often to be resorted to, and your "wrinkles" page often helps out. I have been reading the correspondence in your columns, concerning catering to the B.C.L. The amateur organization has its own magazine to tell what members are doing; so why expect others to do it too! I think you are hitting the happy medium.

Being something of a DX hound, I follow reports with interest, though I have nothing unusual in my log. Regarding daylight DX, one of the St. Louis stations, KMOX, comes in quite often, and some of the Chicago stations. I believe the longest DX record here is one of the California stations, but that is rather vague. My own longest daylight reception was KDKA, 1,050 miles, on an 8-tube set.

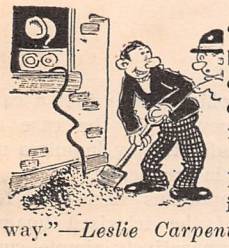
I believe I would sooner have receiving conditions as they are at present in this part of Canada than as they are in most parts of your country. True, the local station is a government monopoly; and I hope it continues to be so, despite the howls of certain business interests, the principal of which seems to be the grain trade, which wants to put in a string of stations across Western Canada, to offset the effect of the wheat pools of the Prairie Provinces.

As for the dollar license fee, in Manitoba only half of it goes to the support of the local station; the other half here and, in the

(*Continued on page* 85)

Broadcastatics

A DX WRINKLE



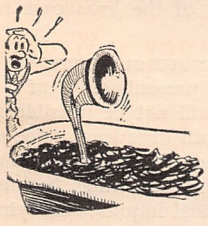
Curious Neighbor: "What's the idea of burying your radio connection in those old coffee grounds for, anyway?"

Boiled Owl: "Oh, I'm just trying to see if I can get Java this way."—*Leslie Carpenter.*

AN UNSOLVED MYSTERY OF RADIO

Set Owner (more in sorrow than in anger): "What I can't understand about this radio business, anyway, is how Static always knows what nights I ask company in to listen to the programs."—*Franklin Nordling.*

PAPA BECAME A SUB-CHASER



"Hey, Willie," called Big Brother, "pa wants to know where his loud speaker is?"

"I got it in the bathtub," said Willie. "I'm playin' submarine, and that's the periscope!"

PLAY THIS ON YOUR PHONOGRAPH

Sweet Young Thing (in music shop): "I'd like to get a good DX record, please. My friends say that every good radio set ought to have one."—*H. N. Webster.*

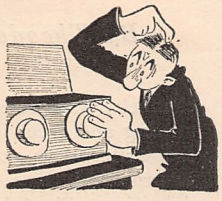
SHE MUST BE A DIVA

Soprano: "I've been out all day shopping, and I certainly got a bargain."

Basso: "What did you buy now?"

Soprano: "I got an expensive new radio set for a song."

MORE BOLSHEVISM



Null: "My set is an I.W.W."

Void: "Waddaya mean, I.W.W.?"

Null: "It Won't Work."

—*H. N. Webster.*

THIS page is devoted to humor of purely radio interest; and our readers are invited to contribute pointed and snappy jokes—no long-winded compositions—of an original nature. For each one of this nature accepted and printed, $1.00 will be paid. Each must deal with radio in some of its phases. Actual humorous occurrences, preferably in broadcasting, will be preferred. Address Broadcastatics, care RADIO NEWS, 239 Fifth Avenue, New York City.

COULD IT HAPPEN TO YOU?

Once there was a Radio Fan so tight he wouldn't send an Applause Card. He went hunting one day, and it began to rain; so he crawled into a hollow log. He felt the thing swell, and was soon wedged in so tight he couldn't get out! As he waited death by starvation, he began to think of all the mean things he had done. Then he thought about the Applause Card and it made him feel so small he crawled right out.

Moral: Don't let a two-cent stamp cause you such misery.—*Leslie Carpenter.*

FINANCIAL CLARIFIER NEEDED

Mabel: "The interference is just awful on our radio. Is yours clear?"

Lillian: "Oh, no, not yet. We've got three more payments on ours."

A FAITHFUL REPRODUCER

Radio Dealer: "And here is just the thing you want for your radio set to make it complete; this is the latest in loud speakers."

Radio Prospect (not a bachelor): "No, never mind showing it; I've got an old model at home now that repeats everything she hears."

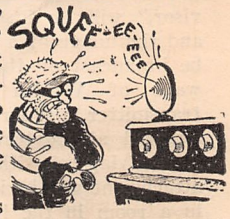
HOME, SWEET HOME!

Jerry: "And how did you enjoy your stay in Havana?"

Carry: "Oh, it was wonderful! Why, we got Kansas City every night on our radio!

—*Mollie Zacharias.*

SHOULD HAVE MASKED HIS VOICE



Smith: "What do you know about this? The paper says that a long-wanted criminal owes his arrest to the radio. Someone recognized his voice in a broadcast."

Jones: "H'm. This isn't the first time the radio has squealed."

CHEAPER TO MOVE—

Jack: "I think I'll have to get a new radio set."

Jim: "Why, what's the matter with the one you have?"

Jack: "I can't meet the payments on it."

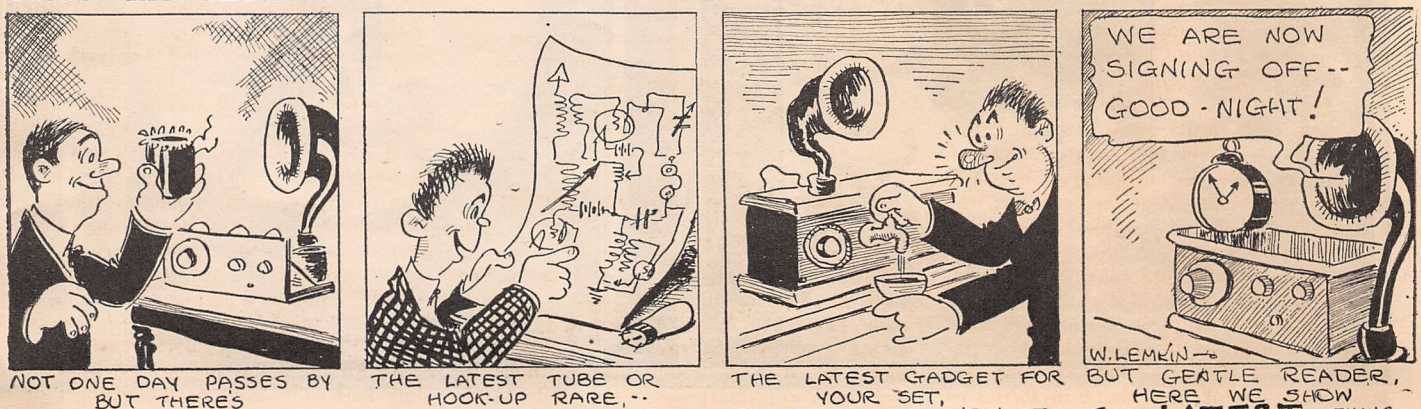
—*Mollie Zacharias.*

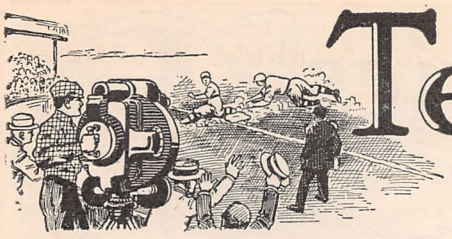
PREVENTING A SHORT CIRCUIT

Nanne: "Why do they call that new catcher a 'super-het?'"

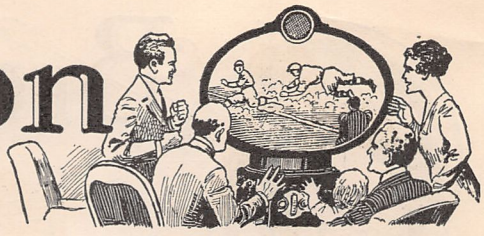
Phanne: "Because he's a receiver that gets everything!"

RADIO RHYMES..... No. 9


NOT ONE DAY PASSES BY BUT THERE'S SOME NEW DEVICE IN RADIO WARES,--
THE LATEST TUBE OR HOOK-UP RARE,-- OR BATTERY BEYOND COMPARE,-
THE LATEST GADGET FOR YOUR SET, OR ELSE THE NEWEST CABINET.
WE ARE NOW SIGNING OFF-- GOOD-NIGHT!
W. LEMKIN
BUT GENTLE READER, HERE WE SHOW THE LATEST THING IN RADIO!



Television



Under this heading, RADIO NEWS publishes each month descriptions of the latest developments in the extremely interesting field of television.

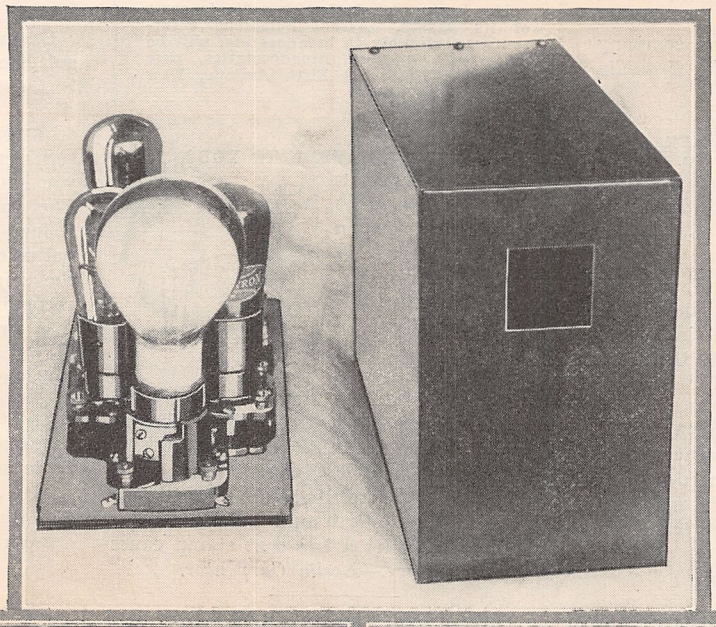
Practical Demonstrations Scheduled for WRNY

By Theodore H. Nakken

WITHIN a short time after the appearance of this issue of RADIO NEWS, the first television broadcasting experiments to be conducted by an American broadcast station, on its regular wave in the 200-500-meter band, will be made over WRNY, New York City. This pioneer work will be done under the direction of the writer with apparatus of his own design and construction. The plan is to give an initial demonstration of the system in the Hotel Roosevelt, New York, where the studio of WRNY is located. A television transmitter, or "televisor," will be installed here; and the image of a person will be broadcast on the 326-meter wave of WRNY from the transmitter proper, which is situated at Coytesville, N. J. A receiving set with a televisor attachment will be in operation in a room in the hotel, where the received images will be observed by the editors of RADIO NEWS, a group of newspaper men and a number of scientists.

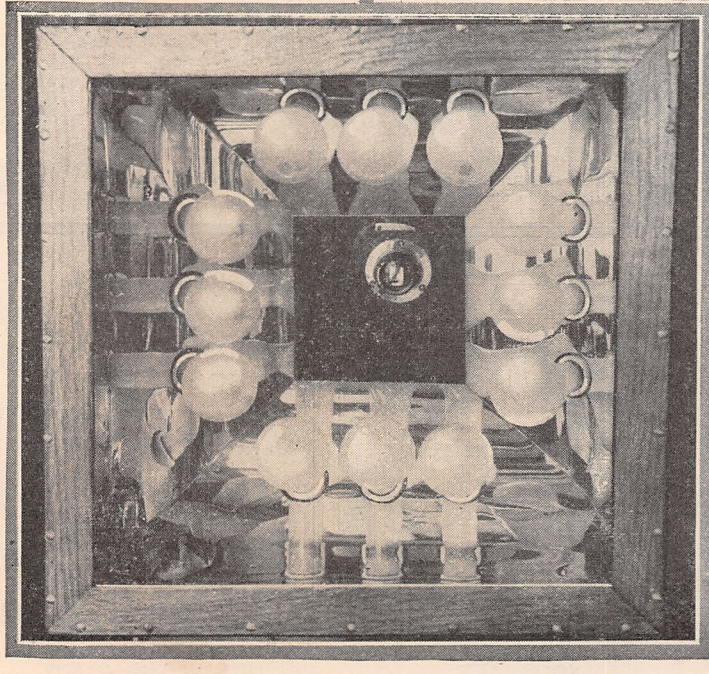
The object of the whole undertaking is to demonstrate the practicability of radio television, on the regular broadcast channels, with comparatively simple transmitting and receiving apparatus. Although the writer does not claim he will be able to provide images of great sharpness, their definition will at least be great enough to make them readily distinguishable to the human eye. The degree of distinctness is limited by the fact that broadcast stations must keep their radiated waves within a 10,000-cycle band; which means that a carrier-wave (920 kilocycles in the case of WRNY) can be modulated by impulses up to only 5,000 cycles in frequency.

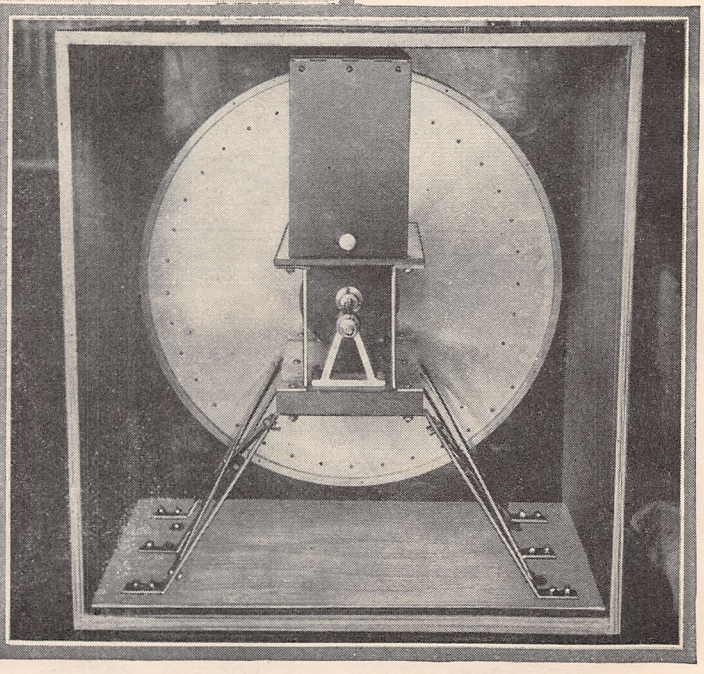
The receiving apparatus necessary for the reproduction of the televised images will be of such comparatively simple construction that any radio experimenter, given the few essential components that he cannot make himself, will be able to assemble a complete instrument in a few evenings. The receiving televisor will form an independent unit, and will be equipped with a cord which will connect to the regular output posts of the broadcast receiver.



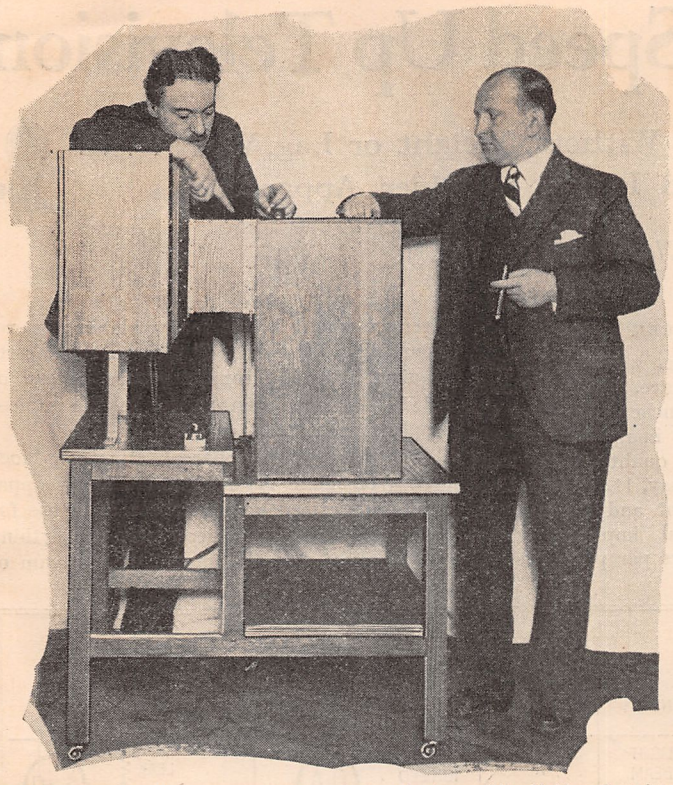
ANNOUNCEMENTS

In the present state of affairs, it will not be possible to receive both broadcast voice or music and the television images at the same time, because the electrical impulses carrying either will occupy the full legal "channel" of the transmitting system. First the WRNY announcer will speak, and then the television broadcasting will commence. There will be a slight pause between the end of the speech and the start of the





Top: The photoelectric-cell unit, removed from its metal container. The cell itself is the pear-shaped bulb in the foreground, the other tubes being A.F. amplifiers. Left: What you would look at if you were being "televised." The round object behind the reflector is a lens. Right: The back of the televisor, showing the photoelectric cell's can behind the revolving disc. The driving motor (not shown) fits on the baseboard.



This illustration gives a general idea of the televisor. Mr. Nakken is pointting to a little window through which the edge of the revolving "scanning" disc may be observed.

MR. THEODORE NAKKEN, the author of the accompanying article, is a prominent radio engineer and inventor, and the holder of what is probably the most important patent in the television field. This patent, No. 1,522,070, reissue No. 16,870 (February 7, 1928), was granted for means of transforming light impulses into electric-current impulses, and covers all practical arrangements of elements and circuits for such transformation. It will, in all probability, be the subject of a great deal of legal controversy and litigation.

This article, the first of a number by Mr. Nakken, heralds a series of practical television demonstrations through the RADIO NEWS broadcast station, WRNY, New York, on its regular 326-meter wavelength. The subsequent articles will describe the transmitting equipment in detail and will tell how the radio fan can make his own television receiver to reproduce the broadcast images.

televisor, to enable the listener to disconnect his loud speaker and to hook on the televisor or receptor. If the speaker is left in the circuit it will emit a confused babble of totally-meaningless noises.

LIMITS OF EXPERIMENTS

It is hoped that, eventually, arrangements will be made for simultaneous transmission of both speech and image, through the use of a separate broadcast station for each purpose. However, radio set owners will have to satisfy themselves with the marvels of television alone until the broadcast licensing situation ceases to be a political football and resumes its proper engineering aspect. The employment of separate transmitting stations will, naturally, necessitate the use of separate receiving sets; but the construction of a second tuner and amplifier to supplement the regular broadcast receiver is a simple matter.

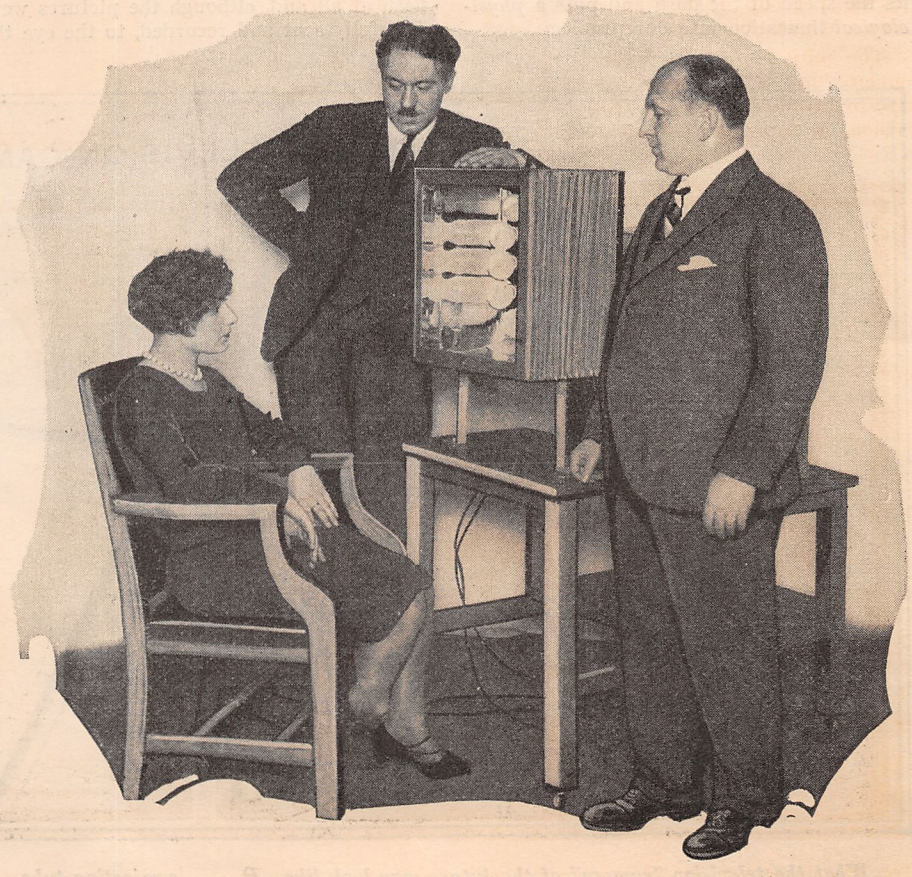
To start with, only faces will be transmitted. The received images appearing on the screen of the televisor will be about two-and-a-half or three inches square, and will appear at the rate of ten per second. This speed is enough to produce the illusion of motion. The minimum number required to produce this effect is eight pictures per second. Because of the inherent limitations and legal requirements of broadcast transmitters, there is little possibility of enlarging the images with pleasing results.

SYNCHRONISM

Both transmitting and receiving televisors will employ revolving discs. The all-important problem of synchronizing them is solved by the use of a manual control at the receiving end. In other words, the operator of the receiving set will adjust the motor by means of a simple regulator (and visible indicator), and thus attain the adjustment that gives the best results. It is not feasible to use synchronous alternating-current motors for general television work, because the motors running televisor transmitters will not be fed by the same power systems that feed receivers in distant districts.

The actual television transmitting apparatus has been practically completed, as the accompanying illustrations show. The model receiver was still in "breadboard" form when this article was being written, so it could not be photographed. However, a detailed description of it will be published in a forthcoming number of RADIO NEWS,

(*Continued on page* 84)



How a person would be "televised." Mr. Nakken, the author, is standing behind his apparatus. At the right is Mr. I. Goldberg, president of the Pilot Electric Mfg. Co., makers of the televisor.

Vacuum Cameras to Speed Up Television

A Ray of Fast-Flying Electrons, Without Weight or Lag, Will Replace Slow-Moving Shafts and Levers of Older Apparatus

By R. P. Clarkson

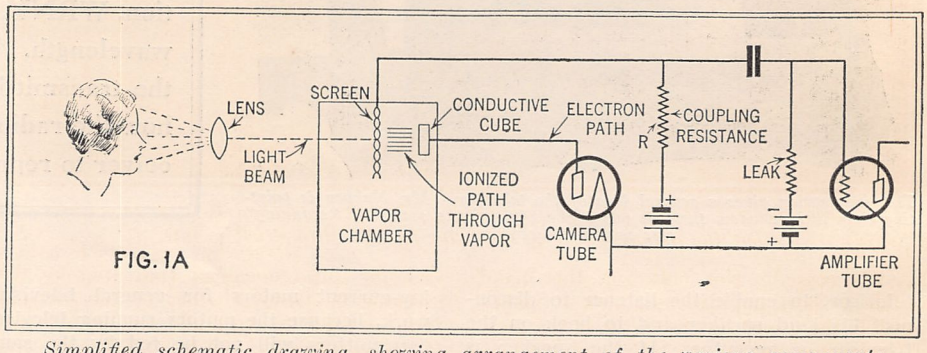
THE three great problems of television of moving objects are first, to analyze into a sufficient number of electrical impulses, the instantaneous image which is to be transmitted, so that the received image is well defined; second, so to transmit the enormous number of resulting impulses per second that the wave keeps within the legal separation of broadcast stations, now set at 5,000 impulses per second; and third, so to project the received impulses that, not only will the entire image be reproduced within one-tenth of a second but, also, each dot of the received image will be of such intensity or of such duration that the eye will retain it while the rest of the image is sent.

Just as a motion picture is a quick succession of "still" pictures, so in television each image is built up of a quick succession of light impulses made visible. Because of the defects of vision, a succession of pictures simulates motion, if they follow each other even at the rate of ten per second but, because of other defects, the eye must see each picture for a definite length of time, depending upon the intensity of its illumination. So, when receiving a television image, the eye will retain all the flashes of light during a tenth of a second because of the "persistence of vision;" but each flash must make a definite register on the eye. This requirement limits the speed of the flash and puts a *physiological* limitation into our problem.

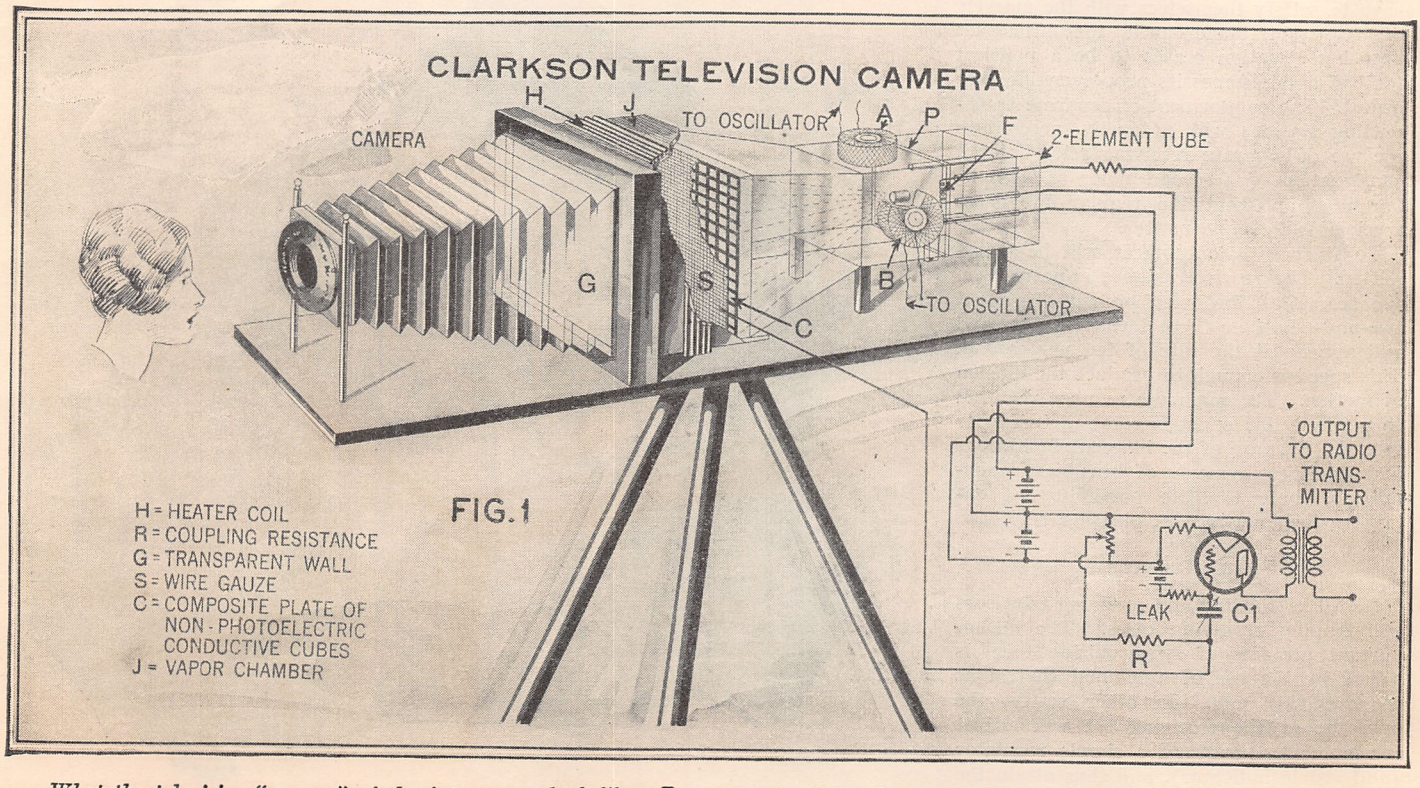
FAST WORK

Suppose, for example, we wish to send an image 10 inches square, which contains, of course, 100 square inches. To have the detail of the resulting image of an ordinary printed magazine quality, there must be provision made for, say, 14,000 variations per square inch in light and shade to be changed into electrical impulses. That means 1,400,000 impulses per picture, or at least 14,000,000 impulses per second for a moving picture; each impulse resulting in a light flash for *one fourteen-millionth part of a second.* The eye wouldn't see this flash at all and, although the pictures were faithfully sent and recorded, to the eye the screen would be perfectly blank. In recording a "fast-motion" picture, such as requires a 1/100-second exposure instead of 1/10, the condition would be the same—only more so!

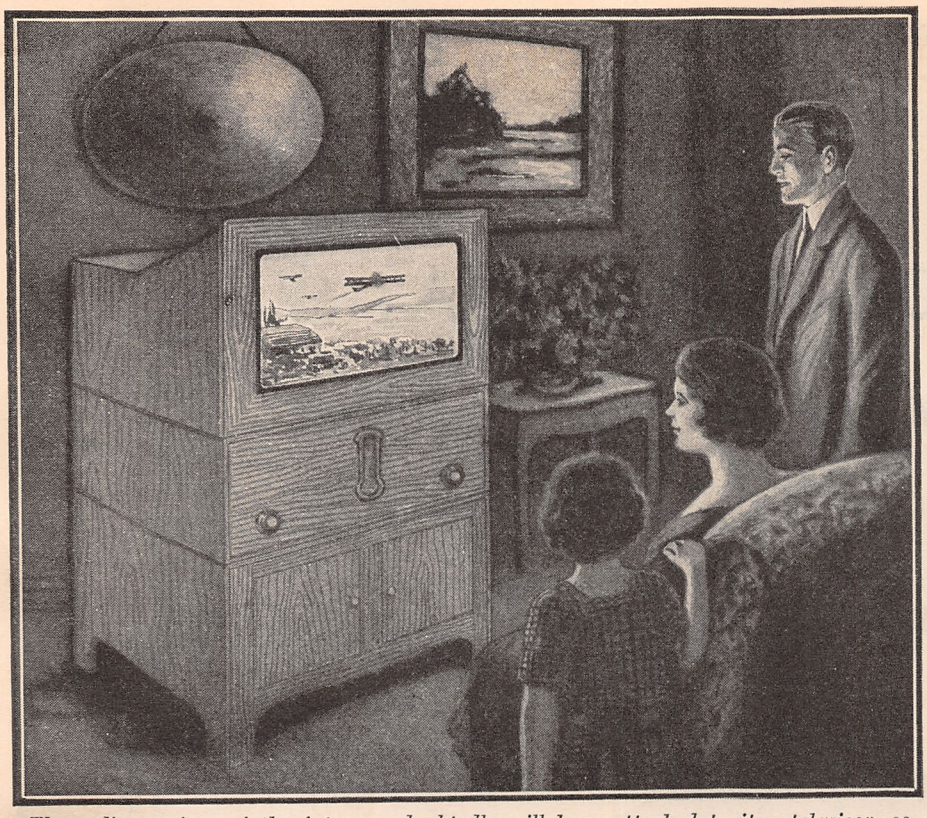
How can this apparent stumbling-block be overcome? My suggestion, in the apparatus described in this article, is to use for the light-flash, not a neon lamp or anything of the sort, but the impact of a stream of electrons on a screen of material which is *not only "fluorescent," but also "phosphorescent."* In other words, to use a screen which not only glows when struck by electrons (as in an oscillograph) but one *which will continue to glow* after the stimu-



Simplified schematic drawing, showing arrangement of the various components of the television apparatus proposed by the author.



What the television "camera" of the future may look like. P and F are plate and filament, respectively, of the electron-projecting tube. A and B are the coils whose magnetic fields influence the electrons which stream through the opening in P.



The radio receiver of the future undoubtedly will have attached to it a televisor, so that the listeners will be able also to "see" broadcast events.

lus has ceased. Not only will this make visible a short impulse but, also, it makes possible the use of less intensity of the glow in order for the eye to be stimulated. It will also lend itself to the blurring of the successive dots of light into each other to imitate more nearly a photograph.

SCANNING APPARATUS

Now, as to dividing the image up into 1,400,000 dots or impulses in one-tenth of a second, no device yet suggested can begin to approach that task. The Nipkow disk with its spiral openings (patented by the inventor in 1884) whether of the original form as used by Alexanderson, with lenses in the openings as used by Baird, with slits as suggested by Rothschild, or in the form of whirling optical plates as Jenkins makes it, is perfectly useless for this purpose; not only because of the limitation on the speed of mechanically-moving parts, not only because of the limitations of size to make room for enough holes, but also because of light limitations, as sufficient light won't pass through the holes. Last, but not least, there is the impossibility of synchronizing the transmitting and receiving disks at that speed.

The only answer I know to this problem is the use of a *weightless beam of electrons moving under the influence of a changing magnetic field.* This is the type of image-scanning device I have suggested in the television camera and projector. To secure a changing magnetic field of any frequency is a simple problem, readily solved by means of a generator or an audio-frequency oscillator.

WAVELENGTH PROBLEMS

Lastly, how can frequencies in the millions be sent, within the legal restriction of 10 kilocycles separation between broadcast stations? This is a problem in which the apparatus for television has no part. The solution is as valuable for increasing the available spectrum for broadcasting as it is for pictures. Just how to solve the problem on the high wavelengths, nobody knows; but the direction in which the solution lies is very clear.

In the first place, why is there such a thing as a "waveband?" Why can't voice or music be sent over the single frequency of the carrier-wave, by *modulating the amplitude* of the wave without affecting the frequency? By our present systems of transmission, we simply add our modulation frequency to the carrier, or subtract it from the carrier, or do both. Nobody knows why this should be necessary; I, for one, believe it isn't necessary. If we have a carrier-wave of 500,000 cycles and send out also a voice-wave of 1,000 cycles, we may make a 501,000-cycle wave, in effect, and a 499,000-cycle wave. These are the two "sidebands." But why not simply depress the tops of every 499 waves, leaving the 500th, so that in our receiver we get the 500,000-cycle wave modulated in *amplitude* to give 1,000 crests or impulses?

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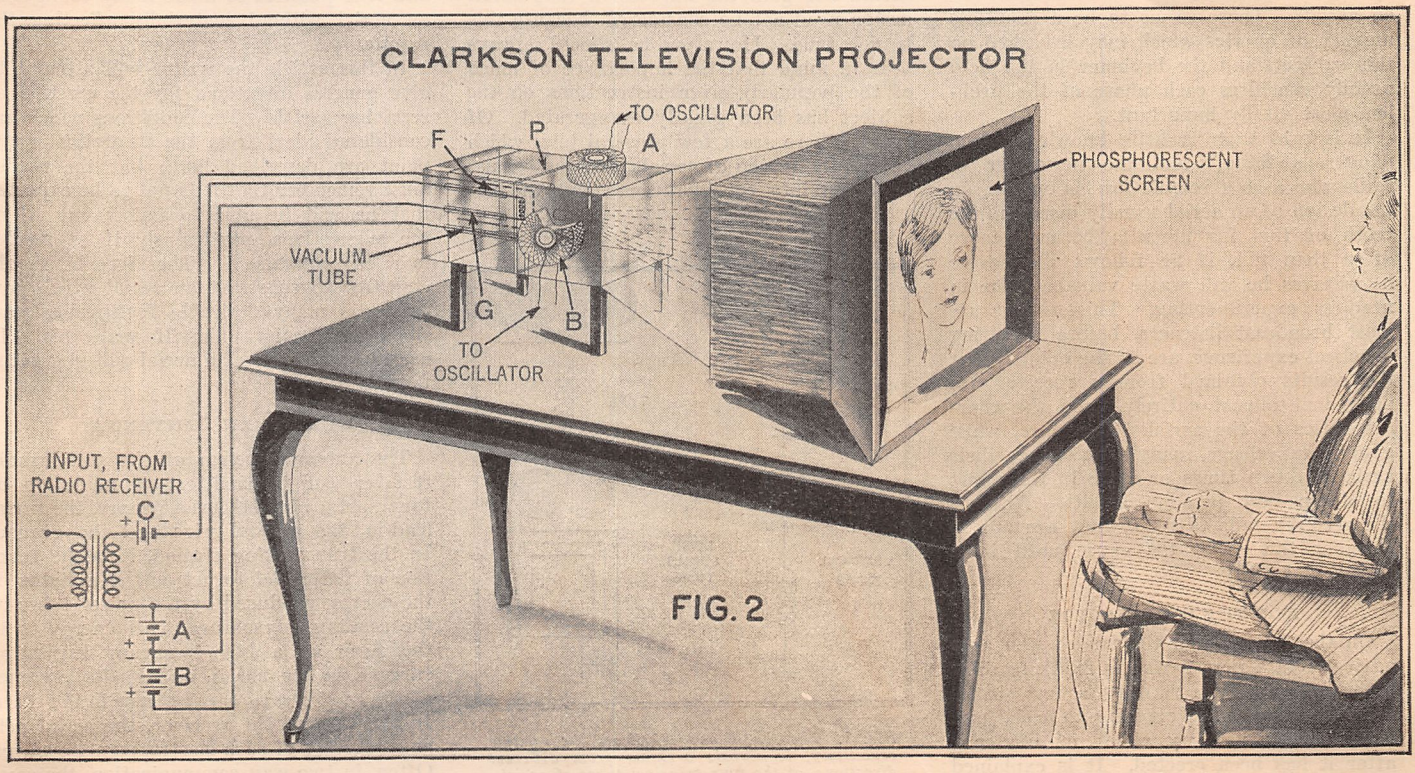


The receiving televisor, similar in construction to the transmitter, makes use of an identical two-element electron-projecting tube. The image will appear on a phosphorescent screen. There are no moving parts at either end, except the electrons.

RADIO AERIALS

What You Should Know About the Various Types in Common Use

by Fred H. Canfield

The aerial of station WMAF, Round Hills, Mass., owned by Col. E. H. Green. Though electrically similar to receiving aerials, transmitting aerials have more, longer and heavier wires, with higher and more substantial masts, and must be highly insulated.

EVERY broadcast listener who is blessed (or cursed, as the case may be) with the slightest knowledge of radio is continually being pestered by his friends and neighbors with questions on aerials. There seems to be a countless number of queries which may be asked on this subject, and the beginner in the field usually considers each phase of the problem most vitally important.

It is said that "a little knowledge is a dangerous thing," and the newcomer in radio who asks a recruit for his opinion on the design of an aerial usually discovers the truth of this for himself; because, more often than not, if he follows the advice he receives he will waste valuable time in needless experimenting. This is because most broadcast listeners, before acquiring practical experience, are of the opinion that the results obtained from a receiver are dependent almost entirely upon the characteristics of the aerial. Therefore, while gaining experience, many fans change their aerial a dozen times or more in the effort to obtain best possible results. Also, if the receiver fails to work, they are apt to consider the aerial the cause until it is proved not guilty.

NOT THE ONLY FACTOR

On the other hand, the novice who asks advice from a person who is really familiar with radio practice receives a few simple rules to follow when erecting an aerial and is told not to worry about its efficiency after it has been erected. It is explained to him that a good set is capable of satisfactory performance, even when a comparatively poor aerial is used; but it is seldom that a poor set can be made to deliver exceptional results by using a good aerial.

From the above statement, the reader should not gain the impression that aerial design need not be considered, because this is not true. However, he should always bear in mind that the importance of much of the popularly-given instructions on the subject has been greatly exaggerated. Of course, there are a few physical laws which govern the design of aerials, and these must be taken into consideration. But the beginner should not become discouraged if it is impossible for him to follow the usual directions exactly; for the rules governing the erection of aerials are quite flexible and it is possible to make many changes in an aerial without materially affecting the results.

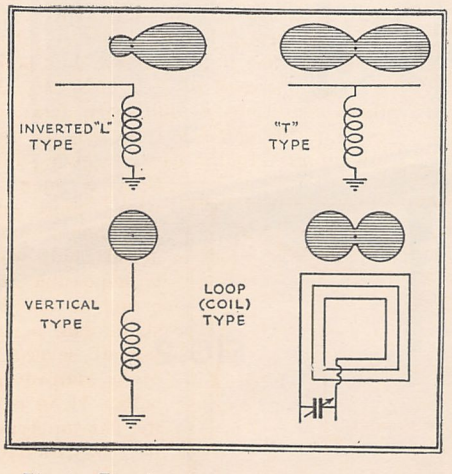


Fig. 1. The shaded areas indicate the relative sensitivity, to signals arriving from different directions, of the four principal types of aerials. The vertical-wire aerial is not directional, the loop most so; but the "T" and "inverted-L" types are most convenient for general use.

In this article the writer will attempt to give general directions for the erection of receiving aerials. The conditions which are considered ideal from the theoretical viewpoint are described here; but the reader must remember that it is not to be expected that he will be able to follow out all of the suggestions, particularly if he resides in a city apartment. Therefore he should endeavor to construct an aerial which possesses as many desirable features as possible, and satisfy himself with this. In most instances such an aerial will give satisfaction.

WHAT IS AN "ANTENNA?"

The antenna system of the usual radio receiver (or transmitter) is made up of four parts; *viz,* the aerial proper, the aerial lead-in, the ground wire and the ground. In the transmitting station, it is the function of the *aerial* to act as the radiator of the energy produced by the power tubes of the sending apparatus. This energy is in the form of a high-frequency oscillating current, in the aerial, and by its presence produces *electromagnetic waves* in the ether. In the case of the receiver, the aerial acts as a *collector* of such electromagnetic waves. Often, in two-way communication, the same aerial is used both for receiving and for radiating radio signals.

Antenna systems used for sending and receiving radio signals are of two general types; first, those which act primarily as electrical condensers and, second, those which act primarily as electrical inductors. The first type is the more generally used, and is the basis of the discussion in this article; it consists of an aerial-and-ground connection. The second type is the *loop antenna,* and this is used only in connection with super-sensitive receivers and for direction-finding purposes. (See Fig. 2.)

THE "CONDENSER" AERIAL

A simple antenna of the condenser type would consist of two metal plates separated by air and insulated from each other except by a wire, known as a lead-in, which connects the receiving or sending apparatus between the two plates. In an antenna system of this type, the efficiency would be determined by the separation between the two plates and by the capacity formed by the two plates. However, from a practical viewpoint, an antenna of this type would not be very satisfactory. In order to make it perform with a high degree of efficiency, the size of the two plates would have to be made so large that the device would be very expensive and also cumbersome.

In actual practice such metal plates are not used as parts of an antenna system. Usually one or more wires are suspended from insulators in the air and these serve in place of one of the plates. The other plate is replaced by the ground itself. The wires suspended in the air are known as the *aerial,* and the air acts *as a dielectric* between the aerial and the ground. Thus it may be seen, the usual antenna system is really a large condenser.

Aerials of different sizes and shapes have been designed to meet different requirements and, by changing the mechanical characteristics of an aerial, it is possible to make it either *"directional"* or *"non-directional,"* and efficient or inefficient. Of course, different rules apply to the design of transmitting and receiving aerials; but the former will not be considered in this article.

LENGTH OF AERIALS

In the first part of this article it was stated that a few simple rules may be used to govern the erection of all types of receiving aerials; these are stated in the following paragraphs.

First, the aerial need not always be long. Many radio fans are under the erroneous impression that an aerial of great length insures excellent reception, but this is not always the case. In most instances, an aerial with an over-all length of approximately 100 feet will provide most satisfactory performance. With an aerial of this length, the average set has sufficient sensitivity to receive distant stations and ample selectivity for separating the local broadcasters. On the other hand, if the aerial were made larger, the set would probably tune broadly and local interference would be experienced; but, if the aerial were shorter, difficulty would be encountered in receiving distant stations.

There are places, however, where aerials either longer or shorter than 100 feet are required. In rural districts, where the nearest broadcast station is more than 25 miles away, interference problems are almost unknown, and, under these conditions, a long aerial, having a length as great as 150 feet, may be used. On the contrary, in congested city districts, where there are several powerful broadcast stations very nearby, it may be found necessary to use a very short aerial. Usually one 75 feet long will be found to possess ample selectivity but, in some cases, it will be necessary to reduce the length of the aerial to 40 or 50 feet in order to eliminate entirely local interference from the receiver.

In computing the length of an aerial, it is important to remember that the *lead-in wire has just as much effect upon the operation of the receiver as the aerial wire itself.* Therefore, if it is desired to erect a 100-foot aerial and the lead-in wire is 20 feet long, the aerial wire should not be more than 80 feet long. This is where a great many listeners make a mistake. Because their aerial wire is only 75 feet long they expect great selectivity; and they are very much surprised to be told that the interference they experience is caused by their

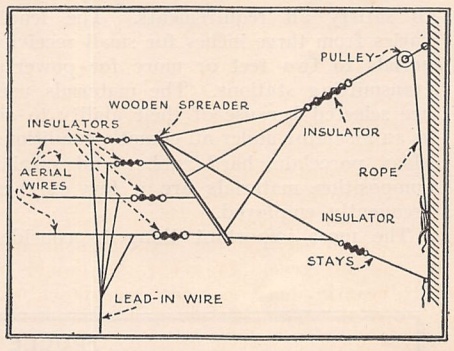


Fig. 5. Flat-top construction is probably most popular in multi-wire receiving aerials. A wooden rod is used as a spreader and the lead-in wire takes the shape of a fan; this diagram shows the usual method of construction.

long aerial, 75 feet of which is lead-in wire.

It frequently happens that a set owner wishes to use a long aerial, but is unable to do so because of lack of space. Under these conditions a multi-wire aerial of the *cage* or the *flat-top* type may be used to advantage. In the usual receiving installation, a long single wire is more satisfactory than a multi-wire aerial; but, where it is impossible to construct a suitable single-wire aerial, the use of several wires often improves results. If an aerial of the flat-top type is to be constructed, two or three wires may be used; but, if a cage-type aerial is decided upon, at least four wires must be employed, for mechanical reasons. Usually, when three or four wires are used, the aerial has an *effective* length approximately 50 per cent greater than its actual length in feet.

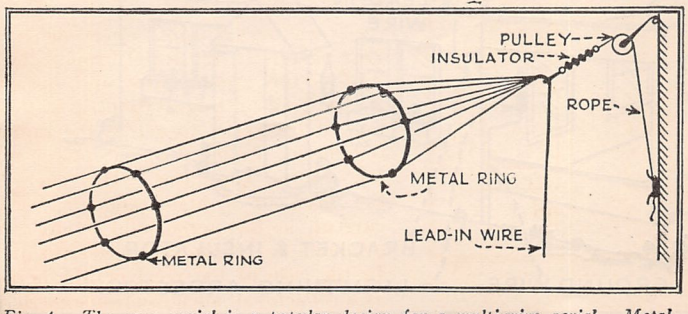


Fig. 4. The cage aerial is a popular design for a multi-wire aerial. Metal rings are used to separate the wires and each wire must be securely soldered to each ring. The rings are spaced 15 or 20 feet apart over the entire length of the aerial.

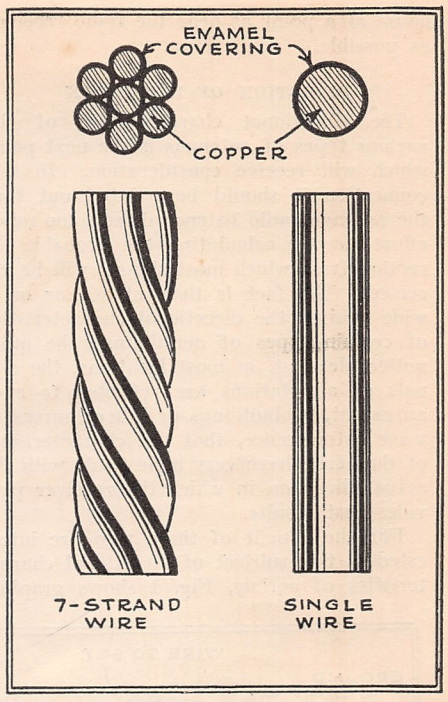


Fig. 6. Radio-frequency current flows on the surface of conductors and R.F. resistance may be decreased by increasing the surface area. With the same amount of metal, stranded wire has a greater surface than solid wire; enamel insulation also increases the surface by separating the strands.

LOCATION AND INTERFERENCE

The second rule to observe, when putting up an aerial, is not to run the wires near buildings, wires, trees or large metal objects. When the aerial wire runs through the branches of a tree, over the metal roof of a building, or *parallel* to telephone or lighting wires, much of the energy is absorbed before it reaches the receiving set. This has the effect of increasing the resistance of the aerial and, as a result, it reduces the sensitivity and the selectivity of the receiver.

Wherever possible, when lighting wires are a problem, the aerial should be so placed that it crosses these wires at right angles. In the case of a metal roof, the aerial should be supported as far above the building as possible; and, where branches of trees cause trouble, they should be so trimmed that they do not come in close proximity to the aerial wires. Often, when a tree is used as a support for an aerial, it is best to terminate the aerial several feet before it reaches the tree, by inserting an insulator between it and the supporting wire leading to the trunk.

After the aerial has been erected, it should be remembered that the lead-in wire requires the same care that was given the aerial. Because the lead-in must enter the house, it is more difficult to keep it away from surrounding objects; but, nevertheless, this is equally as important as in the case of the aerial. Where the wire must follow the side of a house for a distance, it is usually wise to support it on insulators, which should be spaced by brackets at least a foot and a half from the walls of the building. Also, the wire should enter the

house at a point as near the radio receiver as possible.

DIRECTION OF RECEPTION

The directional characteristics of the various types of antennas is the next point which will receive consideration. In this connection it should be pointed out that the average radio listener directs too much effort toward calculating the probable direction from which most signals will be received. The fact is that, at sea or on a wide prairie, the directional characteristics of certain types of aerials may be quite noticeable; but, in most locations, the signals of all stations are reflected to such an extent, by buildings or other sources of wave interference, that the characteristics of the aerial have very little to do with the actual direction in which the receiver provides best results.

For the benefit of those who are interested in this subject of directional characteristics of aerials, Fig. 1 shows graphic-

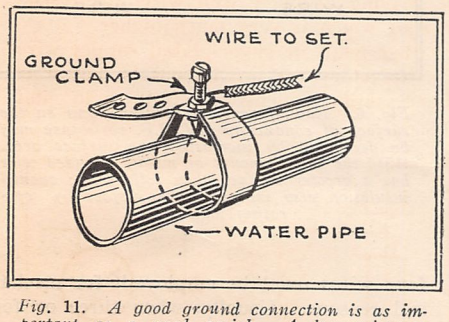


Fig. 11. A good ground connection is as important as a good aerial. A low-resistance connection to a cold-water pipe provides an excellent ground; and the best way to make this connection is with a standard ground clamp.

ally the way in which the various types differ. It will be noticed that the vertical aerial provides uniform reception in all directions and, for this reason, it is the *ideal* type for all purposes. However, for mechanical reasons, this type of aerial construction is seldom used. The "T"-type aerial is the next best, but this is not very popular because it must be twice as long as the inverted-"L"-type aerial, in order to provide the same results. The inverted "L"-type aerial is theoretically the most unsatisfactory of the three, but it is a much more practical design and it actually delivers results entirely satisfactory under most conditions.

The secret of making an aerial non-directional is to support it as high in the air as possible. It has been found that, with aerials less than 20 feet high, the directional characteristics are sometimes quite pronounced; but, as the height is increased, these effects become less noticeable. Aerials from 30 to 60 feet in height are entirely satisfactory for average reception purposes.

Of course, wherever it is possible to do so, one should plan an aerial so that it will run in the direction found most satisfactory for reception in the direction desired. However, where so many fans make their mistake is in an effort to provide the aerial with desirable directional characteristics which causes them to sacrifice other desirable features such as proper length and location, which are usually far more important.

INSULATION

Insulators are an important consideration when erecting a radio aerial. and there are many different types of insulators available for the purpose. In a receiving aerial, the energy which is picked up is very feeble, and it is essential that none of the current be wasted, if distance reception is desired. As it is the purpose of the insulators to prevent the current from leaking to the ground before it passes through the receiver, the importance of good insulation may be appreciated readily.

In a radio aerial, insulators are used at each end; they serve to connect the wire of the aerial to the rope or wire which supports it in position. Also, insulators are connected between the lead-in wire and any support which holds that wire in position. In addition, an insulating tube is required at the point where a lead-in wire enters a building, and the lead-in wire is passed through this insulator. In other words, insulators are used at all points outside the house where it is necessary to provide supports for the aerial or lead-in wires; and it is the purpose of these insulators to prevent the aerial system from coming in close electrical contact with anything which might provide a path to the ground for electricity.

On the inside of a building. it is equally important to prevent leakage of current from the aerial lead-in; but it is easier to insure against such an occurrence, for the woodwork and furnishings are dry and are fairly satisfactory as insulators. Therefore (usually at the point where the lead-in enters the house) an insulated wire is soldered to the bare wire used in the aerial and external portion of the lead-in. The insulation on this wire is all that is considered necessary to prevent leakage.

Outdoor insulators are made in various sizes, and from various materials, in order to satisfy all requirements. The length varies from three inches for small receiving aerials to two feet or more for powerful transmitting stations. The materials used are selected because of their ability to act as an insulator under all climatic conditions; glass, porcelain, hard rubber and special-composition materials are a few of them frequently employed.

The most important thing to consider,

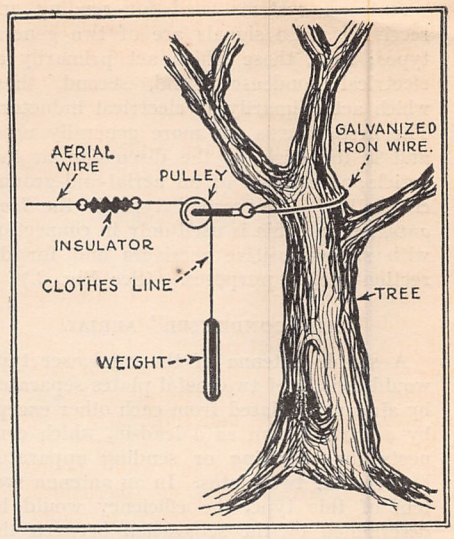


Fig. 3. This drawing shows a suitable method for attaching an aerial to a tree. The weight takes up the slack in the wire at all times, and prevents the wire from breaking when the tree sways in a heavy wind.

when selecting an insulator for outdoor use, is whether it absorbs moisture. For example, a high-quality glass is excellent in this respect because it absorbs practically no moisture, it is a very good insulator, and its shape can be designed to provide ample mechanical strength for the purpose. Porcelain which has been properly glazed is another excellent material for insulation purposes, and the highest-quality insulators of this type possess the same desirable qualities as glass. However, frequently porcelain insulators are glazed only on three sides; such insulators absorb considerable moisture and are therefore unsuited for outdoor use. Usually hard-rubber insulators are not as satisfactory as the two types first referred to. When exposed to the weather hard rubber deteriorates and in time loses its strength; also, in time, the surface becomes rough and as a result holds moisture. There are several composition insulators which are very satisfactory but

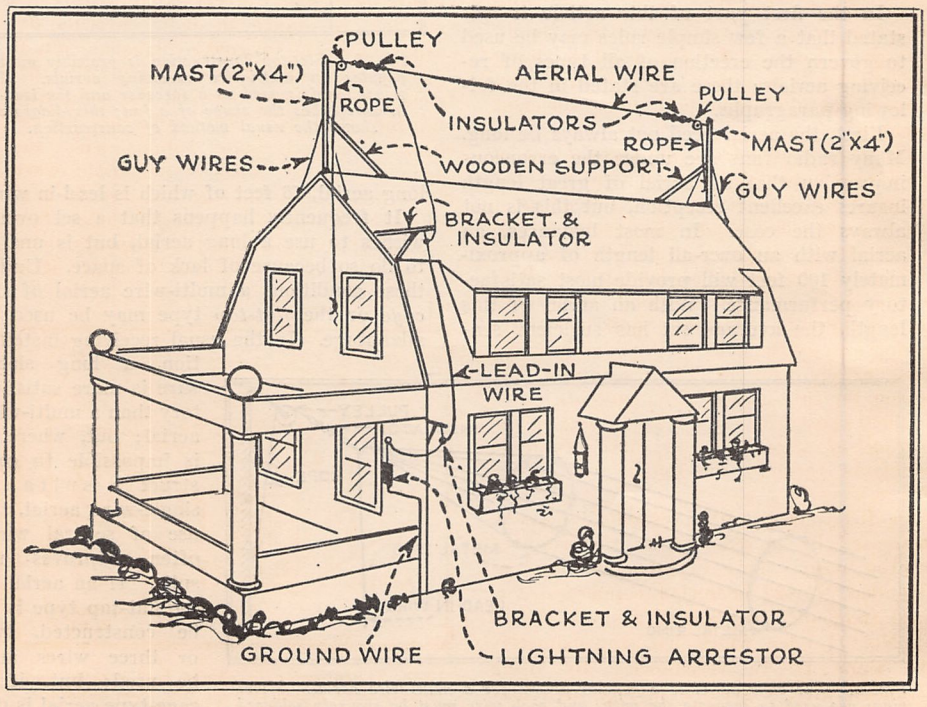


Fig. 7. This drawing gives complete details for constructing an average radio receiving aerial. Masts are used to raise the aerial wire as far from the roof as possible, and brackets keep the lead-in away from the house.

none have the lasting qualities of glass or a high-quality porcelain; *i.e.*, in time they are affected by the weather in one way or another.

CHOICE OF WIRE

The type of wire which will be most satisfactory is another important problem for the set owner to decide. There are as many different kinds of wire which may be used as there are insulators, and each has its particular advantages. For example, wire for use in aerials is made of bare copper, aluminum, phosphor-bronze, copper-clad iron, gold-plated copper and enameled copper. Also, it is available in several sizes, including rope with seven strands of No. 22 and even larger wire, and single strand up to No. 14 and 16 wire.

In selecting wire, the important points to consider are; first, its mechanical strength; second, its resistance to radio-frequency currents; third, its lasting qualities; and, fourth, the ease of making soldered connections to it.

The mechanical strength of aerial wire must be considered when the wire is to be stretched over a long span. Where it is planned to make the aerial 150 feet or more in length, aluminum and copper will not

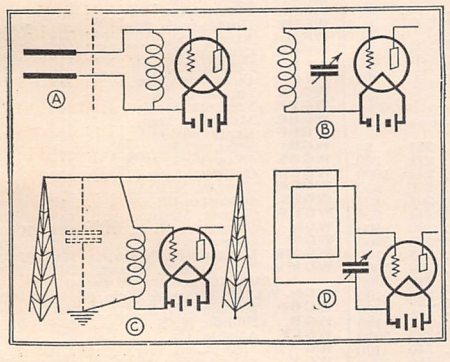


Fig. 2. Every tuned radio circuit must include both inductance and capacity; we see here how this rule applies to the antenna circuit of receivers. Figs. A and C show an aerial-and-ground system in schematic and picture form; Figs. B and D, the circuit of the loop antenna.

be satisfactory for the purpose and either phosphor-bronze or copper-clad iron should be used. However, for the usual receiving aerial which is less than 150 feet in length, copper and aluminum both have sufficient strength.

The *R.F.* (radio-frequency) *resistance* of the wire is important, regardless of the type of aerial which is being constructed; as it has a great effect upon the electrical efficiency of the antenna system. In this connection, it should be explained that R.F. resistance is entirely different from D.C. (direct-current) resistance, and two wires having exactly the same D.C. resistance may have entirely different R.F. resistances. The reason for this is that *R.F. currents* (such as those caused by radio waves) *flow on the surface of wire,* whereas direct currents penetrate through the entire wire. (See Fig. 6.)

In R.F. circuits the resistance may be decreased by increasing the surface area of the wire. This explains why seven-stranded No. 22 enameled copper wire is used frequently in place of a single strand of No. 14 wire which has approximately the same D. C. resistance. By using stranded wire, a greater surface area may be obtained with the same quantity of metal; and, by insulating each strand with

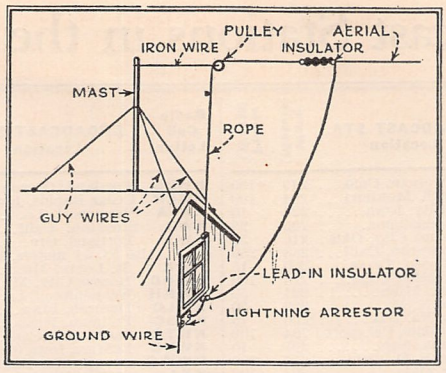


Fig. 9. This drawing shows an excellent arrangement for a receiving aerial. When this method is followed, both the aerial and lead-in wires are kept free from obstructions. The aerial wire may be fastened to either a tree or another building.

enamel, the effective surface is still further increased.

EFFECT OF CORROSION

The quality of the metal *on the surface* of the wire, also, has an effect upon the R. F. resistance. For example, the R.F. resistance of a length of clean copper wire might be originally 10 ohms; but, after it has been exposed to the weather for a few months, the corrosion on the surface might increase the resistance of the wire to 15 ohms for R.F. currents.

In the wires made and sold especially for aerials, many methods have been used to decrease the surface resistance of the wire. Probably the most popular is the use of an enamel covering, which protects the metal from the weather and, in this way, prevents corrosion. Other manufacturers gold-plate the wire, as gold is a good conductor and is not subject to corrosion. In the case of the copper-clad iron wire, the makers take advantage of the fact that R.F. currents flow on the surface of the wire, and use a less expensive but stronger metal in the core of the wire.

Single-strand, enameled copper wire of No. 14 or No. 12 gauge is probably the most popular and most satisfactory wire for receiving purposes. This wire has sufficient mechanical strength and offers a very low resistance to R.F. currents, its enamel covering prevents corrosion, and it is easily soldered. There is very little difference in efficiency between the solid wire and the stranded. The difference in resistance between solid copper wire and enameled copper wire is negligible when the wire is new; but the increase in R.F. resistance caused by corrosion after four months of exposure to the elements often causes a decrease in signal strength of as

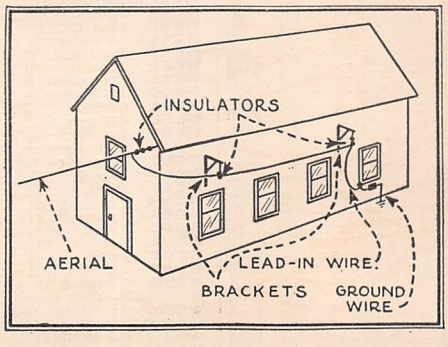


Fig. 8. In order to obtain best results, the lead-in wire should be kept free from buildings. Where necessary, brackets should be erected to support the wire at least 18 inches from the building.

much as 25 per cent. Therefore, the enamcled covering is highly desirable, and this is particularly true in large cities because of acid fumes liberated by factories and coal-burning furnaces.

Aluminum wire is not very satisfactory for radio aerials. The tensile strength of aluminum is not very great and it cannot be soldered with ordinary solder; also, it corrodes very rapidly. Phosphor-bronze wire possesses characteristics which are similar to those of copper, but has greater strength. As bronze is more expensive than copper, there is no advantage in using it, except in cases where a very long aerial is to be erected. Also, bronze wire is not sold with enamel insulation and, as it corrodes, it may not be as satisfactory as enameled copper. Copper-clad iron wire, when new, is equally as efficient as copper from the electrical viewpoint and, in addition, it is much stronger mechanically. However, it is not generally available with enamel insulation, and it must in time be replaced because the copper coating wears off, leaving ordinary iron wire, the resistance of which is very much higher.

Either gold- or silver-plated copper wire is satisfactory for use in aerials, but it is unnecessarily expensive. Both gold and

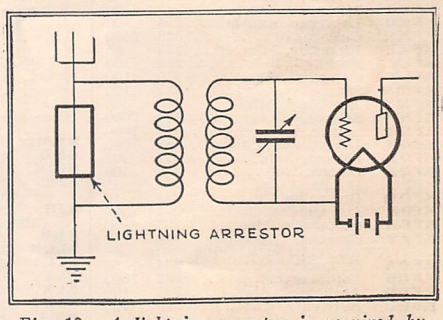


Fig. 10. A lightning arrestor is required by the insurance regulations, in every case where an outside aerial is used. This device is connected across the aerial and ground wires, at the point where they enter the house, to conduct atmospheric electricity direct to ground.

silver are good conductors of electricity; however, the thin gold or silver plating is apt to wear off in a very short period of time, leaving bare copper wire.

CONNECTIONS

When putting up an aerial, joints in the wire should always be carefully made. In all cases where it is possible to do so, joints should be avoided; as they are a constant cause of trouble. For example, the aerial and lead-in may often be one length of wire; thus eliminating a joint at a place where it is difficult to make a repair and still more difficult to discover a defect.

When making joints in aerial wires, both the mechanical and electrical efficiency of the connection must be considered. In the aerial wire, if a connection is not mechanically strong, a strong wind is apt to blow down the aerial. Likewise, if a good electrical connection is not made, the air will be apt to corrode the wire and increase the resistance of the aerial. Good electrical connections in the aerial are far more important than in any other part of the radio installation, because the action of the elements will quickly render a poor contact valueless. Therefore, it is highly important that all joints be soldered.

Although the ground wire is not a part of

(*Continued on page* 82)

List of Broadcast Stations in the United States

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA	East Pittsburgh, Pa.	**316	50000
	(Also 62.5, 42.95, and 27 meters and other short-wave transmissions on varying power.)		
KDLR	Devils Lake, N. D.	231	15
KDYL	Salt Lake City, Utah	234	500
KEJK	Los Angeles, Cal.	252	250
	(6XAN 105.9 meters, 250 watts)		
KELW	Burbank, Calif.	229	500
KEX	Portland, Ore.	278	2500
KFAB	Lincoln, Neb.	319	5000
KFAD	Phoenix, Ariz.	322	500
KFAU	Boise, Idaho	286	*2000
KFBB	Havre, Mont.	275	50
KFBK	Sacramento, Calif.	275	100
KFBL	Everett, Wash.	224	50
KFBU	Laramie, Wyo.	484	500
KFCB	Phoenix, Ariz.	*244	125
KFCR	Santa Barbara, Calif.	211	100
KFDM	Beaumont, Texas.	484	500
KFDX	Shreveport, La.	236	250
KFDY	Brookings, S. D.	545	500
KFDZ	Minneapolis, Minn.	216	10
KFEC	Portland, Ore.	214	50
KFEL	Denver, Colo.	227	250
KFEQ	St. Joseph, Mo.	231	*1000
KFEY	Kellogg, Idaho	232	10
KFGQ	Boone, Iowa	210	10
KFH	Wichita, Kan.	246	500
KFHA	Gunnison, Colo.	250	50
KFHL	Oskaloosa, Iowa	213	10
KFI	Los Angeles, Calif.	468	5000
KFIF	Portland, Ore	229	50
KFIO	Spokane, Wash.	246	100
KFIU	Juneau, Alaska	225	10
KFIZ	Fond du Lac, Wis.	**268	100
KFJB	Marshalltown, Iowa	248	*100
KFJF	Oklahoma City, Okla.	273	5000
KFJI	Astoria, Ore.	250	50
KFJM	Grand Forks, N. D.	333	100
KFJR	Portland, Ore	240	500
KFJY	Fort Dodge, Iowa	232	100
KFJZ	Fort Worth, Texas	250	50
KFKA	Greeley, Colo	250	*500
KFKB	Milford, Kansas	242	*1500
KFKU	Lawrence, Kansas	254	500
KFKX	Chicago, Ill.	526	2500
KFKZ	Kirksville, Missouri	225	15
KFLV	Rockford, Ill.	268	100
KFLX	Galveston, Texas	270	100
KFMR	Sioux City, Iowa	232	100
KFMX	Northfield, Minn.	236	500
KFNF	Shenandoah, Iowa (day)	461	2000
KFOA	Seattle, Wash.	447	1000
KFON	Long Beach, Calif.	242	1000
KFOR	Lincoln, Neb.	217	100
KFOX	Omaha, Neb.	258	100
KFPL	Dublin, Texas	275	15
KFPM	Greenville, Texas	231	15
KFPR	Los Angeles, Calif.	232	250
KFPW	Carterville, Mo.	263	50
KFPY	Spokane, Wash.	246	250
	(7XAB. 105.9 meters, 100 watts)		
KFQA	St. Louis, Mo.	234	50
KFQB	Fort Worth, Texas	333	1000
KFQD	Anchorage, Alaska	345	100
KFQU	Holy City, Calif.	220	100
	(Also 31, 53, 63, 106 meters, 50 watts)		
KFQW	Seattle, Wash.	217	100
KFQZ	Hollywood, Calif.	232	250
	(Also 108.2 meters, 50 watts)		
KFRC	San Francisco, Calif.	454	1000
KFRU	Columbia, Missouri	250	500
KFSD	San Diego, Calif.	441	500
KFSG	Los Angeles, Calif.	252	500
	(Has short-wave transmitter)		
KFUL	Galveston, Texas	258	500
KFUM	Colorado Spgs., Colo.	486	1000
KFUO	†Clayton, Mo.	545	*1000
KFUP	Denver, Colo.	227	100
KFUR	Ogden, Utah	227	50
KFUS	Oakland, Calif.	208	50
KFUT	Salt Lake City, Utah	250	50
KFVD	Venice, Calif.	216	250
	(Also 105 meters, 50 watts)		
KFVG	Independence, Kan	225	50
KFVI	Houston, Texas	238	50
KFVS	Cape Girardeau, Mo.	**224	50
KFWB	Los Angeles, Calif.	353	1000
	(Also 105 and 40 meters, 50 watts)		
KFWC	Ontario, Calif.	248	100
KFWF	St. Louis, Mo.	214	250
KFWI	San Francisco, Cal.	268	500
KFWM	Oakland, Calif.	236	*500
KFWO	Avalon, Calif.	300	250
	(Also 53.07 meters, 100 watts)		
KFXD	Jerome, Idaho	204	*15
KFXF	Denver, Colo.	283	250
KFXJ	†Edgewater, Colo. (near)	210	50
KFXR	Oklahoma City, Okla.	224	50
KFXY	Flagstaff, Ariz.	205	25
KFYO	Breckenridge, Tex.	212	100
KFYR	Bismarck, No. Dak.	250	*250
KGA	Spokane, Wash.	261	2000
KGB	San Diego, Calif.	248	100
	(Also 65.18 meters)		
KGAR	Tucson, Ariz.	234	100
KGBU	Ketchikan, Alaska	400	500
KGBX	St. Joseph, Mo.	288	100
KGBY	Columbus, Nebraska	222	50
KGBZ	York, Nebraska	213	100
KGCA	Decorah, Iowa	248	10
KGCB	Oklahoma City, Okla.	216	50
KGCH	Wayne, Nebraska	294	250
KGCI	San Antonio, Texas	220	250
KGCL	Seattle, Wash.	231	100
KGCN	Concordia, Kansas	208	50
KGCR	Brookings, So. Dak.	208	15
KGCU	Mandan, No. Dak.	240	100
KGCX	Vida, Montana	244	10
KGDA	Dell Rapids, So. Dak. (daytime)	254	15
KGDE	Barrett, Minn.	205	50
	(Also 40 meters, 50 watts)		
KGDM	Stockton, Calif.	217	10
KGDP	Pueblo, Colo.	224	10
KGDR	San Antonio, Texas	207	15
KGDW	Humboldt, Neb.	294	100
KGDY	Oldham, So. Dak.	207	15
KGEF	Los Angeles, Calif.	263	1000
KGEK	Yuma, Colo. (day)	263	10
KGEN	El Centro, Calif.	225	100
KGEO	Grand Island, Neb.	205	100
KGEQ	Minneapolis, Minn.	204	50
KGER	Long Beach, Calif.	216	100
KGES	Central City, Neb.	204	10
KGEW	Fort Morgan, Colo.	219	*100
KGEZ	Kalispell, Montana	294	100
KGFB	Iowa City, Iowa	224	10
KGFF	Alva, Oklahoma	205	25
KGFG	Oklahoma City, Okla.	216	50
KGFH	La Crescenta, Calif.	263	250
KGFI	San Angelo, Texas	220	15
KGFJ	Los Angeles, Calif.	213	100
KGFK	Hallock, Minn.	224	50
KGFL	Raton, N. M.	222	50
KGFN	Aneta, No. Dak.	200	15
KGFO	Los Angeles, Cal. (port.)	204	100
KGFW	Ravenna, Neb.	207	10
KGFX	Pierre, S. D. (day)	254	200
KGGF	Picher, Okla.	207	100
KGGH	Cedar Grove, La.	213	50
KGGM	Inglewood, Calif. (port.)	204	100
	(6XAI, 66.04 meters; 50 watts)		
KGHA	Pueblo, Colo.	210	500
KGHB	Honolulu, Hawaii	227	250
KGHC	Slayton, Minn.	210	15
KGHF	Pueblo, Colo.	210	250
KGHG	McGehee, Ark.	000	50
KGHI	Little Rock, Ark.	000	15
KGHL	Billings, Mont.	222	250
KGHO	Fort Stockton, Texas	000	50
KGHX	Richmond, Texas	000	50
KGHP	Hardin, Mont.	263	50
KGJF	Little Rock, Ark.	000	250
KGKO	Wichita Falls, Texas	000	250
KGO	Oakland, Calif.	**384	5000
	(Short-wave transmitter, 10 to 40 meters, 10,000 watts)		
KGRC	San Antonio, Texas	220	250
KGRS	Amarillo, Texas	244	*250
KGTT	San Francisco, Calif.	220	50
KGU	Honolulu, Hawaii	270	500
KGW	Portland, Oregon	492	1000
KGY	Lacey, Wash.	246	50
KHJ	Los Angeles, Calif.	400	1000
	(Also 104.1 meters; 50 watts)		

THE list of stations here corresponds to the latest list of licenses issued by the Radio Commission at the time of going to press; and is subject to changes ordered by the regulating authority after May 10, 1928.

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KHMC	Harlingen, Tex.	236	100
KHQ	Spokane, Wash.	370	1000
KICK	Red Oak, Iowa (day)	322	100
KJBS	San Francisco, Calif.	245	100
	(6XAR, 62 meters; 50 watts)		
KJR	Seattle, Wash.	349	2500
	(Also 105.2 meters; 5 to 250 watts)		
KKP	Seattle, Wash.	203	15
KLCN	Blytheville, Ark. (day)	286	50
KLDS	Independence, Mo.	270	1500
KLS	Oakland, Calif.	246	250
KLX	Oakland, Calif.	508	500
KLZ	†Dupont, Colo	353	1000
KMA	Shenandoah, Iowa	395	1000
KMBC	see KLDS		
KMED	Medford, Oregon	270	50
KMIC	Inglewood, Calif.	224	250
KMJ	Fresno, Calif.	366	50
KMMJ	Clay Center, Neb.	286	*250
KMO	Tacoma, Wash.	254	500
KMOX	†St. Louis, Mo.	300	5000
	(Also 49 meters, 15 watts)		
KMTR	Los Angeles, Calif.	516	500
	(Also 108.2 meters; 250 watts)		
KNRC	Santa Monica, Calif.	375	500
	(Also 108.2 meters; 100 watts)		
KNX	Los Angeles, Calif.	337	500
	(Also 107.1 meters; 100 watts)		
KOA	Denver, Colo.	**326	5000
KOAC	Corvallis, Oregon (day)	270	7000
KOB	State College, New Mex	395	*5000
KOCH	Omaha, Neb.	258	250
KOCW	Chickasha, Okla.	252	250
KOIL	Council Bluffs, Iowa	319	5000
	(9XU, 61.06 meters, 500 watts)		
KOIN	†Portland, Oregon	319	1000
KOMO	Seattle, Wash.	309	1000
KOOS	Eugene, Ore.	207	50
KORE	Eugene, Ore.	200	50
KOW	Denver, Colo.	219	250
KPCB	Seattle, Wash.	231	100
KPJM	Prescott, Ariz.	214	15
KPLA	Los Angeles, Calif.	288	500
KPNP	Muscatine, Iowa	211	100
KPO	San Francisco, Calif.	422	1000
KPOF	Denver, Colo.	201	500
KPPC	Pasadena, Calif.	316	50
KPRC	Houston, Texas	294	1000
KPSN	Pasadena, Calif.	316	1000
KQV	Pittsburgh, Pa.	270	500
KQW	San Jose, Calif.	297	500
KRAC	Shreveport, La.	220	50
KRE	Berkeley, Calif.	231	100
KRLD	Dallas, Texas	461	500
KRSC	Seattle, Wash.	273	50
KSAC	Manhattan, Kansas	333	500
KSBA	†Shreveport, La.	268	1000
KSCJ	Sioux City, Iowa	244	*500
KSD	St. Louis, Mo.	545	500
KSEI	Pocatello, Idaho	333	250
KSL	Salt Lake City, Utah	303	5000
KSMR	Santa Maria, Calif.	273	100
KSO	Clarinda, Iowa	227	500
KSOO	Sioux Falls, So. Dak.	210	*250
KSTP	Westcott, Minn.	220	*2000
KTAB	Oakland, Calif.	280	500
KTAP	San Antonios, Texas	229	250
KTBI	Los Angele, Calif.	275	1000
KTBR	Portland, Oregon	229	500
KTHS	Hot Springs, Ark.	500	*1000
KTNT	Muscatine, Iowa	256	2000
KTSA	San Antonio, Texas	265	2000
KTUE	Houston, Texas	213	5
KTW	Seattle, Wash.	395	1000
KUJ	Seattle, Wash.	200	10
KUOA	Fayetteville, Ark.	297	1000
KUOM	Missoula, Mont.	461	500
KUSD	Vermillion, So. Dak.	484	250
KUT	Austin, Texas	232	500
KVI	Tacoma, Wash.	283	250
KVL	Seattle, Wash.	273	100
KVOO	Tulsa, Okla.	349	5000
KVOS	Bellingham, Wash.	210	250
KWBS	Portland, Oregon	200	50
KWCR	Cedar Rapids, Iowa	240	250
KWEA	Shreveport, La.	213	100
KWG	Stockton, Calif.	345	50
KWJJ	Portland, Ore.	250	50
	(Also 53. 54 meters, 100 watts)		
KWK	St. Louis, Mo.	234	*1000
KWKC	Kansas City, Mo.	222	100
KWKH	Kennonwood, La.	395	3500
KWLC	Decorah, Iowa	248	50
KWSC	Pullman, Wash.	395	500
KWTC	Santa Ana, Calif.	273	100
KWUC	LeMars, Iowa (day).	**244	1500
KWWG	Brownsville, Texas	278	500
KXA	Seattle, Wash.	535	500
KXL	Portland, Ore.	220	250
KXRO	Aberdeen, Wash.	224	50
KYA	San Francisco, Calif.	361	1000
KYW	Chicago, Ill.	534	*2500
KZM	Oakland, Calif.	231	100
NAA	Arlington, Virginia	**434	1000
WAAD	Cincinnati, O.	231	25
WAAF	Chicago, Ill.	389	500
WAAM	Newark, N. J.	268	250
	(Also 65.18 meters, 50 watts)		
WAAT	Jersey City, N. J.	246	300
WAAW	Omaha, Neb. (daytime)	441	500
WABC	Richmond Hill, N. Y.	309	*2500
	(Also 64.0 meters, 500 watts)		
WABF	Kingston, Pa.	205	250
WABI	Bangor, Me. (Sundays)	389	100
WABO	See WHEC		
WABW	Wooster, Ohio	248	50
WABY	Philadelphia, Pa.	248	50
WABZ	New Orleans, La.	238	50
WADC	Akron, Ohio	238	1000
WAFD	Detroit, Mich.	231	100
WAGM	Royal Oak, Mich.	225	50
WAIT	Taunton, Mass.	214	10
WAIU	†Columbus, Ohio	283	5000
WAIZ	Appleton, Wis.	227	100
WALK	Willow Grove, Pa.	201	50
WAMD	†St. Paul, Minn.	222	500
WAPI	Auburn, Ala.	341	1000
WASH	Grand Rapids, Mich.	256	250
WATT	Boston, Mass (portable)	201	100
WBAA	West Lafayette, Ind.	**273	500
WBAK	Harrisburg, Pa. (day).	300	500
WBAL	†Baltimore, Md.	**286	5000
WBAO	Decatur, Ill.	268	100
WBAP	Fort Worth, Texas	500	5000
WBAW	Nashville, Tenn.	240	5000
WBAX	Wilkes Barre, Pa.	250	100
WBBC	Brooklyn, N. Y.	227	500
WBBL	Richmond, Va.	234	100
WBBM	†Glenview, Ill.	**389	5000
WBBP	Petoskey, Mich.	240	100
WBBR	Rossville, N. Y.	256	1000
WBBW	Norfolk, Va.	236	100
WBBY	Charleston, So. Car.	250	75
WBBZ	Chicago, Ill. (portable)	204	100
WBCN	Chicago, Ill.	288	*500
WBES	Takoma Park, Md.	265	100
WBET	Medford, Mass.	288	500
WBIS	See WNAC		
WBMH	Detroit, Mich.	211	100
WBMS	Union City, N. J.	200	100
WBNY	New York, N. Y.	236	500
WBOQ	Richmond Hill, N. Y.	309	500
WBOW	Terre Haute, Ind.	208	100
WBRC	Birmingham, Ala.	303	250
WBRE	Wilkes Barre, Pa.	250	100
WBRL	Tilton, N. H.	232	500
	(1XY, 105, 109 meters, 250 watts)		
WBRS	Greenville, N. Y.	211	250
WBSO	Wellesley Hills, Mass.	384	100
WBT	Charlotte, No. Car.	258	1000
WBZ	†Springfield, Mass.	*333	15,000
	(Has short-wave transmitter)		
WBZA	Boston, Mass.	*333	500
WCAC	Mansfield, Conn.	535	500
WCAD	Canton, N. Y.	244	*500
WCAE	Pittsburgh, Pa.	461	500
WCAH	Columbus, Ohio	234	250
WCAJ	Lincoln, Neb. (day)	380	500
WCAL	Northfield, Minn.	286	500
WCAM	Camden, N. J.	224	500
WCAO	Baltimore, Md.	244	250
WCAP	Asbury Park, N. J.	240	500
WCAT	Rapid City, So. Dak.	248	100
WCAU	Byberry, Pa.	261	1000
WCAX	Burlington, Vermont.	254	100
WCAZ	Carthage, Ill.	250	50
WCBA	Allentown, Pa.	222	100
WCBD	Zion, Ill.	345	5000
WCBE	New Orleans, La.	227	250
WCBM	Baltimore, Md.	225	100
WCBR	Providence, R. I. (port.)	201	100
WCBS	Springfield, Ill.	210	250
WCCO	†Minneapolis, Minn.	**405	*5000
WCDA	Cliffside, N. J.	213	250
WCFL	Chicago, Ill.	484	1500
WCGU	Brooklyn, N. Y.	219	500
	Also 54 meters, 150 watts)		
WCLB	Long Island City, N. Y.	200	100
WCLO	Kenosha, Wisc.	227	100
WCLS	Joliet, Ill.	216	500
WCMA	Culver, Ind.	261	500
WCOA	Pensacola, Fla.	250	500
WCOC	Columbus, Miss.	231	500
WCON	Danbury, Conn.	265	100
WCOT	Providence, R. I.	225	100
WCRW	Chicago, Ill.	224	500
WCSH	Portland, Maine	366	5000
	(Also 63.79 meters, 250 watts)		
WCSO	Springfield, Ohio	256	500
WCWK	Fort Wayne, Ind.	214	250
WCX	See WJR		
WDAE	Tampa, Fla.	268	500
WDAF	Kansas City, Mo.	370	1000
WDAG	Amarillo, Texas	263	1000
WDAH	El Paso, Texas	234	100
WDAY	Fargo, No. Dakota	545	*250
WDBJ	Roanoke, Va.	231	250
WDBO	Orlando, Fla.	288	*500
	(4XE, variable, 250 watts)		
WDEL	Wilmington, Del.	297	100
WDGY	Minneapolis, Minn.	286	500
WDOD	Chattanooga, Tenn.	244	500
WDRC	New Haven, Conn.	283	500
WDWF-WLSI	Cranston, R. I.	248	250
WDZ	Tuscola, Ill. (daytime)	278	100
WEAF	†Bellmore, N. Y.	**492	50,000
WEAM	North Plainfield, N. J.	263	250
WEAN	Providence, R. I.	275	500
WEAO	Columbus, Ohio.	283	750
	(Also 54.02 meters, 250 watts)		
WEAR	Cleveland, Ohio.	**400	1000
WEBC	Superior, Wis.	242	*250
WEBE	Cambridge, Ohio	248	10
WEBH	Chicago, Ill.	366	*500
WEBJ	New York, N. Y.	**256	500
WEBQ	Harrisburg, Ill.	224	15
WEBR	Buffalo, N. Y.	242	200
WEBW	Beloit, Wis.	258	500
WEDC	Chicago, Ill	242	500
WEDH	Erie, Pa.	219	30
WEEI	Boston, Mass.	508	500
WEHS	Evanston, Ill.	216	100
WEMC	Berrien Spgs., Mich.	484	1000
WENR	see WBCN		
WEPS	Gloucester, Mass.	297	100
WEVD	Woodhaven, N. Y.	**256	500
WEW	St. Louis, Mo. (day)	353	1000
WFAA	Dallas, Texas	545	500
WFAM	St. Cloud, Minn.	252	10
WFAN	Philadelphia, Pa.	224	500
WFBC	Knoxville, Tenn.	234	50
WFBE	Cincinnati, Ohio.	246	250
WFBG	Altoona, Pa.	268	100
WFBJ	Collegeville, Minn.	273	100
WFBL	Syracuse, N. Y.	258	750
WFBM	Indianapolis, Ind.	275	1000
WFBR	Baltimore, Md.	244	*250
WFBZ	Galesburg, Ill.	248	50
WFCI	Pawtucket, R. I.	242	100
WFDF	Flint, Mich	273	100
WFI	Philadelphia, Pa	405	500
WFIW	Hopkinsville, Ken.	261	1000
WFJC	Akron, Ohio.	227	500
WFKB	Chicago, Ill.	224	500
WFKD	Philadelphia, Pa.	248	50
WFLA	Clearwater, Fla.	517	750
WGAL	Lancaster, Pa.	252	15
WGBB	Freeport, N. Y.	246	150
WGBC	Memphis, Tenn	229	15
WGBF	Evansville, Ind.	236	250
WGBI	Scranton, Pa.	231	250
WGBS	†New York, N. Y.	349	500
WGCM	Gulfport, Miss.	222	15
WGCP	Newark, N. J.	268	250
WGES	†Chicago, Ill.	242	500
WGHP	†Fraser, Mich.	278	750
WGL	†Secaucus, N. J.	294	1000
WGM	Jeannette, Pa.	208	50
WGMS	Minneapolis, Minn.	246	500
WGMU	New York, N.Y. (port.)	201	100
	(Also 106 meters, 50 watts)		
WGN-WLIB	Chicago & Elgin, Ill	416	15,000
WGOP	Flushing, N. Y.	200	100
WGR	Buffalo, N. Y.	303	750
WGST	Atlanta, Ga.	270	500
WGWB	Milwaukee, Wis.	270	250
WGY	Schenectady, N. Y.	**380	50,000
	(Also on 31.4, 21.96, and sometimes 5 meters)		
WHA	Madison, Wisc.	333	750
WHAD	Milwaukee, Wisc.	270	500
WHAM	Rochester, N. Y.	*280	5000
	(Has short-wave transmitter)		
WHAP	†Carlstadt, N. J.	236	1000
WHAS	Louisville, Ky.	322	500
WHAZ	Troy, N. Y. (Monday)	306	500
WHB	Kansas City, Mo.	341	500
WHBA	Oil City, Pa.	261	10
WHBC	Canton, Ohio	236	10
WHBD	Bellefontaine, O.	222	100
WHBF	Rock Island, Ill.	222	100
WHBL	Sheboyan, Wis.	204	*250
WHBM	Chicago, Ill. (portable)	201	100
WHBP	Johnstown, Pa.	229	*250
WHBQ	Memphis, Tenn	232	100
WHBU	Anderson, Ind.	220	15
WHBW	Philadelphia, Pa.	220	100
WHBY	West De Pere, Wis.	250	50
WHDI	Minneapolis, Minn.	246	500
WHEC-WABO	Rochester, N. Y.	254	*250
WHFC	Chicago, Ill.	216	200
WHK	Cleveland, Ohio.	**265	*500
	(Also 66.04 meters, 500 watts)		
WHN	New York, N. Y.	395	500
WHO	Des Moines, Iowa	535	5000
WHPP	Englewood, N. J.	205	10
WHT	†Chicago, Ill.	306	5000
WIAD	Philadelphia, Pa.	288	100
WIAS	Ottumwa, Iowa (day)	322	100
WIBA	Madison, Wis.	240	100
WIBG	Elkins Pk., Pa. (Sund'ys)	441	50
WIBJ	Chicago, Ill. (port.)	201	100
WIBM	Chicago, Ill. (port.)	201	100
WIBO	†Chicago, Ill.	306	5000
WIBR	Steubenville, Ohio	250	50
WIBS	Elizabeth, N. J.	204	250
WIBU	Poynette, Wis.	217	20
WIBW	Topeka, Kan.	204	250
WIBX	Utica, N. Y.	238	*150
WIBZ	Montgomery, Ala.	231	15
WICC	Easton, Conn.	265	500
WIL	St. Louis, Mo.	258	250
WIOD	Miami Beach, Fla.	248	1000
WIP	Philadelphia, Pa.	349	500
WISN	Milwaukee, Wis.	270	250
WIVA	Norfolk, Va.	210	100
WJAD	Waco, Tex.	333	500
WJAG	Norfolk, Neb.	286	*250
WJAK	Kokomo, Ind.	234	50
WJAM	Cedar Rapids, Iowa	240	250
WJAR	Providence, R. I.	484	500
WJAS	Pittsburgh, Pa.	270	500
WJAX	Jacksonville, Fla.	341	1000
WJAY	Cleveland, Ohio	227	500
WJAZ.	†Mt Prospect, Ill	263	5000
WJBA	Joliet, Ill	248	50
WJBB	Sarasota, Fla.	238	250
WJBC	LaSalle, Ill.	227	100
WJBI	Red Bank, N. J.	263	250
WJBK	Ypsilanti, Mich.	220	15
WJBL	Decatur, Ill.	213	250
WJBO	New Orleans, La.	263	100
WJBT	Chicago, Ill.	389	500

(Continued on page 53)

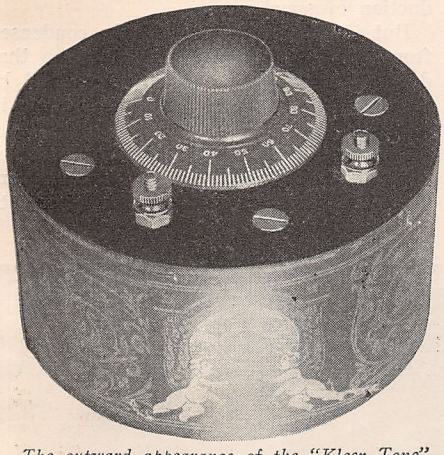
*Allowed higher daylight power, **Standard or constant-frequency transmission. † Remote Control.

How the Radio Public is Being Fooled

Number Two of a Series of Articles Exposing Exaggerated Claims and Unfair Selling Methods in Radio

EVERY industry is continually harassed by its own fakes and swindles. The radio industry, during the past four or five years, had had within its ranks a considerable number of firms of the "fly-by-night" variety, who have preyed upon the gullible and who have made it all the more difficult for the legitimate manufacturers to do business. Every time a swindle is perpetrated upon the public, the public loses confidence and, after a while, it becomes increasingly difficult for a legitimate firm to prosper.

RADIO NEWS in the past has taken pains to expose a good deal of radio merchandise which was designed only to pry away some extra dollars from set owners; but it seems that there is an unending procession of such material and RADIO NEWS feels it a continuing duty to expose false pretences ruthlessly, in order to protect the public from get-rich-quick devices, which often do only harm and in no case accomplish anywhere near what their sponsors claim for them.



The outward appearance of the "Kleer Tone" radio cure-all.

We have today, for instance, the noteworthy Geppert "Kleer-Tone", which has been advertised in quite a few mediums and has even been accepted by radio publications that ought to know better. A great many of the readers of this magazine have asked us as to its value and the truth of the claims made for it.

The device in question consists of an innocent-looking round box, as shown in our illustration. It measures about four inches in diameter and about three inches in height over all. Upon dissecting it in the RADIO NEWS Laboratories, it was found to be an ordinary radio-frequency transformer, the secondary of which is tuned by a variable condenser. There is nothing else contained in the device, either within or without, yet listen to the exorbitant claims made by the manufacturers.

A RADIO CURE-ALL

The following is taken verbatim from a circular (published by The Geppert Mfg. Co., Hewitt Building, Des Moines, Iowa).

IN the June issue of RADIO NEWS appeared an exposure of a "gyp" radio store and the shady methods employed to rope in purchasers. This article describes a device extensively advertised in exaggerated terms; it is but one of many. Our readers are invited to co-operate by sending in, for investigation by laboratory tests, advertisements which do not seem to be trustworthy.—EDITOR.

"Better Radio from any set instantly"

"Remarkable invention, ends interference, reduces static a new way"

"It offers agents an amazing opportunity to earn $150 to $300 a week"

"Big quick cash"

"Now the final answer to imperfect radio reception"

"Amazing invention improves reception of any set instantly—almost beyond belief"

"Reduces static; sends interference to the vanishing point"

The following statement, displayed prominently in box copy, says:

"See what it does:

(1) Eliminates 50 to 90% of Static.
(2) Increases Volume.
(3) Brings in More Distant Stations.
(4) Tunes out Powerful Local Stations.
(5) Gives your Set at Least One More Stage.
(6) Separates Low Wave Length Stations.
(7) Saves 30 to 40% on Batteries."

In addition to this, the circular tells you how to get one of the famous Geppert "Kleer-Tone" outfits free. This is how it works out:

THE ROAD TO WEALTH!

"Now is the time for action. Now, if ever! Here is my *FREE TRIAL OFFER* and my *MONEY-BACK AGREEMENT*: Fill out and mail the enclosed card. Send no money. Right away we will send you two Geppert Kleer-Tones—one for your own radio, and one to start you on the big money-making thrill of your life.

"Pay the postman for only one Kleer-Tone—the other is *FREE*. Sell the extra Kleer-Tone to your nearest neighbor, and then your own won't cost you a penny.

Money Back if Not Delighted

"Furthermore, I guarantee to refund your money if you are not satisfied and delighted. That's how marvelous the Geppert is! That's what I think of it, and that's how I stand back of it.

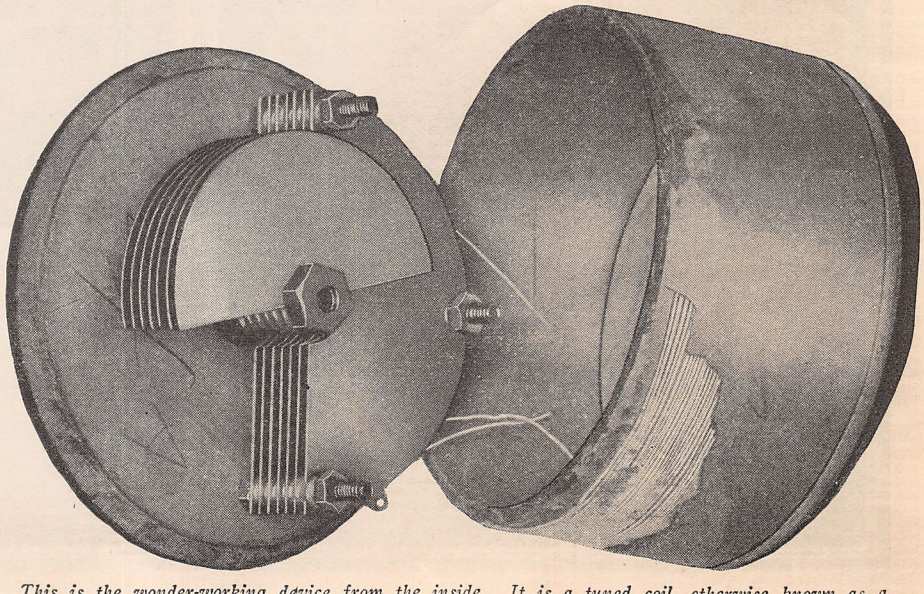
Refund Plus 50c

"If you don't feel satisfied, return the Geppert within 10 days, and I'll refund your deposit and pay you a half dollar extra for your trouble. So you see I am the only one who can lose, if the Geppert does not more than meet your expectations. There is only one thing to do, and that is to act now.

Mail the Card Today

"This trial offer is limited. It is strictly introductory and only for the purpose of advertising, and naturally cannot be continued indefinitely. Sit down now and mail

(*Continued on page* 74)



This is the wonder-working device from the inside. It is a tuned coil, otherwise known as a wavetrap. If advertised and sold as such, no exception could be taken to it, except that the quality is not high compared to the price.

Radio Aerials Create No Lightning Hazard

Laboratory Experiments with High Voltages Create Thunderstorm Conditions and Show That Lightning Does Not Leave Its Path for Aerials

By Baron Manfred von Ardenne
(Berlin, Germany)

IT is a phenomenon well-known in meteorology, that the atmosphere in its various layers exhibits an electrical potential increasing with its height above the earth. This is easily demonstrated by connecting one pole of an *electrometer* to a device which ionizes the air in its immediate vicinity; if this device is elevated to a substantial distance above the earth, the electrometer will almost infallibly show a potential of several hundred volts.

The increase of voltage with height, in the atmosphere, depends somewhat on the geographical location, as well as the time of the day and of the year; while the cause is not as yet thoroughly understood, it is almost certainly due to radiation from the sun. (See "Summer Radio Reception" in RADIO NEWS for June 1926, "Sun Spots and Radio" in SCIENCE AND INVENTION for August, 1926, previously referred to in this issue, and "Aerial Electricity and the Solar Cycle," in RADIO NEWS for June, 1927, for discussions of this matter.)

The "potential gradient," as it is called, has a value often as great as 45 volts for every foot of height above the earth's surface, even in good weather, when there is no sign of a storm. If we take this as a base for our calculations, we will find that at three miles above the earth there will

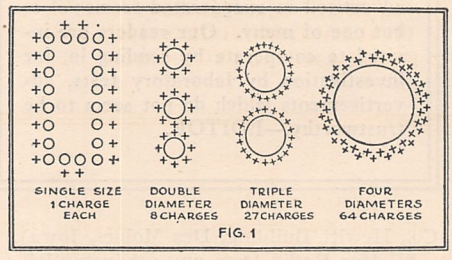


FIG. 1

Every molecule of water with an electric charge adds more to the voltage of the drop to which it joins itself. The voltage increases in direct proportion to the diameter.

be a charge of about 700,000 volts on the molecules of water-vapor which are always present. Such a voltage is sufficient to produce electric sparks from three to seven feet in length; but this is insignificant compared with the distance separating it from the earth.

GREAT CONCENTRATION OF VOLTAGE

However, the comparatively-trifling voltage mentioned can be enormously increased, if the water-vapor is condensed into drops; the limit of voltage obtainable depends only on the rapidity of the condensation, which is regulated by the temperature and speed of the air currents causing this effect. If, as under ordinary fair-weather conditions, the condensation is gradual, the electricity will be dissipated through the sunlit and ionized air, and the voltage of the atmosphere will be equalized without the production of sparks.

But if the vapor is suddenly condensed from a gaseous to a liquid state, so that drops of water are formed, there will be caused an enormous and instant increase in voltage.

The weight of a single molecule, which is the fundamental unit of water, and cannot be divided without separating it into

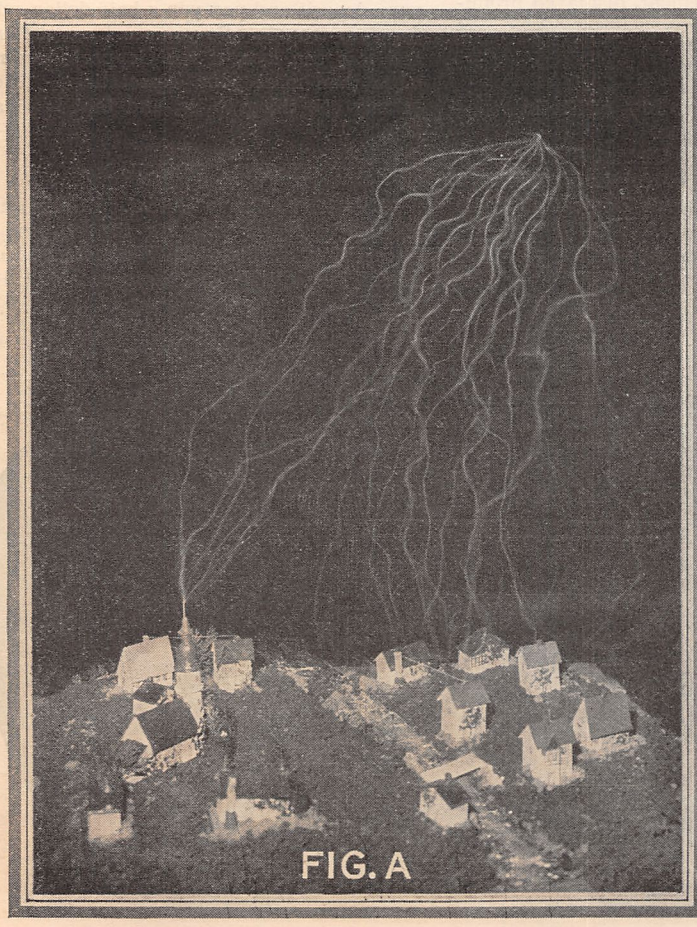


FIG. A

FIG. B

Fig. A is a composite picture, made from a photographic plate exposed to many "lightning" discharges on the miniature village. The aerials are conspicuously untouched. Fig. B shows how the laboratory discharge "forks" like real lightning.

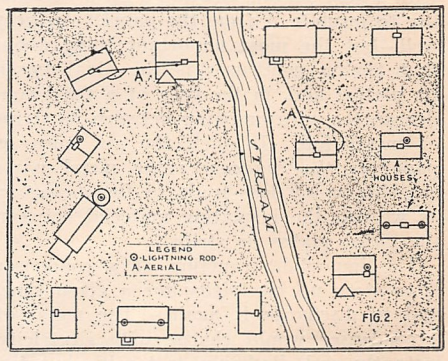
THE question has been often asked, "Do radio sets draw lightning?" The obvious reply is that they are less likely to do so than electric flat-irons, for instance; and the inquiry which was conducted, into the actual records of lightning damage, by RADIO NEWS three years ago and accompanied by a $300 prize offer, is instructive by the *negative* results obtained. The one or two instances which have been sent us since then, of damage to radio receivers by lightning, have been so few, in comparison to the number of homes struck by lightning (and a fair share of which must be presumed to have radio installation) that the conclusion is warranted that RADIO DOES NOT CREATE A LIGHTNING HAZARD. The insurance companies, who have a direct financial interest in the matter, came very early to that conclusion.

In this article, Baron von Ardenne, one of Europe's most famous radio engineers, gives RADIO NEWS an exclusive resumé of the results of researches carried out with artificial lightning. This has hitherto been produced in laboratories, with interesting results; but this article details the first experiments of this nature made to determine the effects of aerial installations. The article will be found worth while from the theoretical side; and its conclusions will be of practical interest to radio set owners—that a properly-installed aerial is far safer than electric-light connections and ACTUALLY DIMINISHES THE RISK FROM LIGHTNING.—EDITOR.

two chemically-different gases, is about 5555 times 10^{-25} grains. (This is a short way of writing a fraction which has 25 figures to the right of the decimal point, and of which the first 21 are ciphers.) The weight of a raindrop of average size, about one-sixth of an inch in diameter, is about half a grain. That is to say, the drop contains 835 times 10^{18} molecules of water (another short way of writing 835 with 18 ciphers after it.) The electric charges of all these molecules are concentrated *on the surface of the single drop.*

A well-known law of electricity tells us that the voltage is equal to the total charge divided by the area of the surface over which it is distributed. If a thousand little spheres with identical surfaces and electric charges (and consequently the same voltage) are brought together and combined into a large one, the big sphere will have a thousand times the charge of any of the small ones, but only a hundred times its surface. Therefore, its voltage will be ten times greater. (The contents of a sphere increase as the *cube* of its diameter; the area as the *square;* consequently the voltage of spheres thus combined will be increased as the cube root of the number brought together. See Fig. 1 for an illustration of the idea.)

Then, applying this law to the case of the raindrop above described, we find that the voltage which it has collected will be about 9.4×10^6 (or 9,400,000) times greater than that of the voltage on the molecules of the water while it was still in the form of vapor. If the voltage on the water-vapor was 700,000, that on the drop would then reach the incredible figure of more than *six and a half trillion volts* the instant that the drop was formed. A voltage very much less than this would be able to strike through the distance between the highest rain clouds and the earth.



This "map" shows the arrangement of the little village pictured below.

(For some further information as to the nature of the voltages thus formed, the

(*Continued on page* 78)

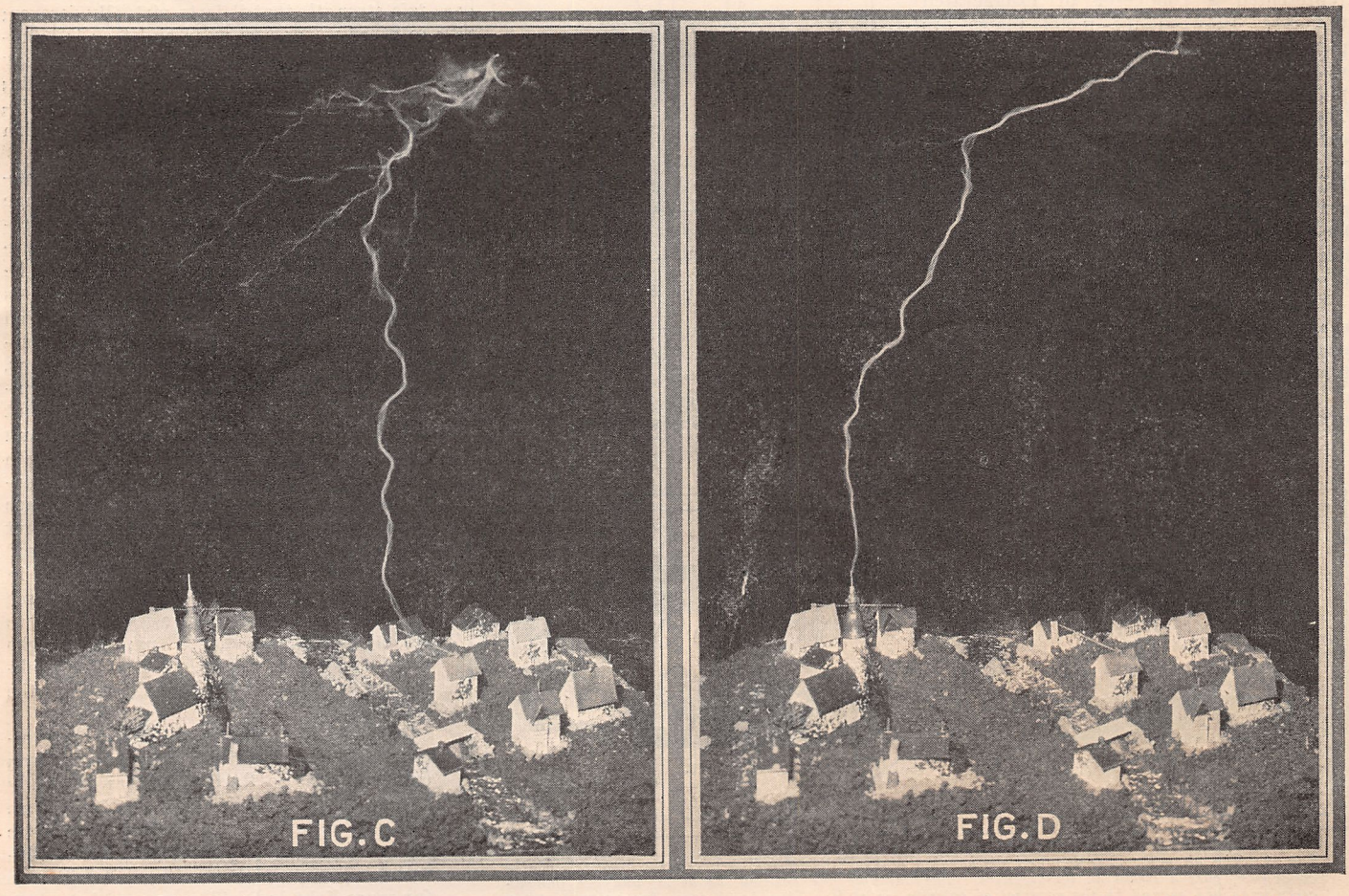


Fig. C is one of the few cases where it was possible to get a stroke on an aerial. A suitable lightning arrester makes one safe as a lightning rod. Fig. D shows a full stroke on the lightning rod of the church tower, behind which is an aerial.

What Is the Life of a Fixed Condenser?

Why There is Invisible Wear and Tear, on the Inside of This Hermetically-Sealed Radio Component, that Will Finally Destroy It

THERE are very few things more deceptive than a condenser. The average user is inclined to think that a condenser is a bunch of metal plates with a knob on one end and a strip of bakelite to insulate it from the panel. All very well—but the most important thing about that tuning condenser is the air between its plates; and, in the case of a fixed condenser, the mica or paper between its strips of metal foil. In fact, the air, mica or paper *is the condenser;* the metal parts are simply low-loss leads to the *dielectric,* as we call the insulating material between the metal plates or strips.

The important function of a condenser is to store up electricity for a given time, and to discharge it again. The metal of a condenser would charge with electricity instantly and discharge instantly; but the insulating material, or dielectric, of the condenser takes time to charge and time to discharge. That is why a condenser can be used to regulate the frequency of a radio circuit, or to take up impulses from an audio or a power circuit. The larger the condenser, the more effectively we can charge the non-conducting material in it, and the longer it will retain the charge.

At A in the accompanying figure we have represented a condenser of exaggerated thinness. Between the metal plates are particles of non-conducting material. They will take an electric charge from the metal plate adjoining them, *but not instantly.* The particles of air, or mica, or paper carrying a charge are at once put under a strain which tends to rearrange them. Particles of air can move freely; but they are so good an insulator that it takes a long time for a charge to leak across an air gap; and a high voltage to break it down.

When we reverse the current, as at B, the charge on the metal plates of the condenser reverses also; thus bringing a positive charge of the metal against negative charges on the dielectric. Immediately every particle of the insulating matter in the dielectric is put under a pressure which swings it, as far as possible, end for end. These are "molecular" motions, too small to be seen with a microscope, but they exist in the dielectric, and raise its temperature; while loose electrons and other infinitesimal particles work their way finally through, producing a "leakage current." This causes a loss of efficiency in the condenser circuit, usually measured under the rather deceptive title of "A.C. resistance."

FIXED CONDENSERS WEAR OUT

The strain on the dielectric, in the case of a tuning condenser which uses air in that capacity, is not serious, so far as the lasting characteristics of the condenser are concerned. Air is still quite inexpensive; and the wearing out of the condenser can be expected to take place first in its mechanical parts. However, the fixed condenser, with a paper dielectric, is in a little different case. Just because it does not move, light up, or heat noticeably in the course of its operation, gives no reason to suppose that it is inert. On the contrary,

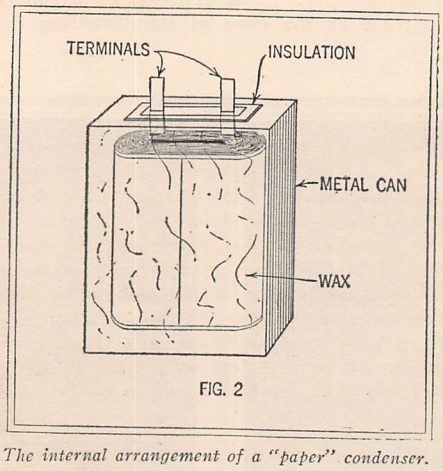


FIG. 2

The internal arrangement of a "paper" condenser.

it is the field of a great deal of electrical, magnetic and other invisible activities which will finally wear it out in due course of time. It is the quality of the dielectric material used in the condenser, as well as its use or abuse in the matter of applied voltage, that determines its life.

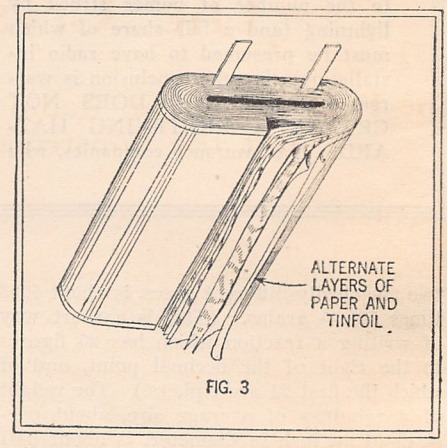


FIG. 3

The condenser is made of two long strips of tinfoil, spaced by several sheets of thin insulating paper, and rolled into a compact mass.

The usual mica condenser employed in radio reception is employed at such a low electrical strain, compared with its *dielectric strength,* that it lasts virtually forever; in other words, the wear and tear is infinitesimal. The small mica condenser may have a dielectric strength of 5,000 volts; hence an applied voltage of 100 or less involves no appreciable effect on the condition of the condenser.

In the paper or filter condenser, however, it is different. The applied voltage usually approaches close to the safe dielectric strength of the condenser, so that there is certain to be real wear and tear. The greatest factor of wear in this instance is the slow disintegration of the paper used for the dielectric. There is always a certain amount of leakage, or current-flow, from one plate to the other plate in a condenser. This leakage-current singles out the weakest spots in the dielectric, and more and more current flows through such parts in the vast spread of dielectric material. This action is accelerated (since more current means more concentrated heat and increased weakness, while increased weakness spells accelerated current-flow) in a vicious cycle. Perhaps if we could see such action under the ultra-microscope, we might observe countless minute sparks gnawing away at the dielectric at the weakest point, and steadily increasing the opening.

The life of a paper condenser is comparable to that of an incandescent lamp. You expect at least a thousand hours of steady service from a lamp. Yet the first time you use the lamp, it may blow out, because it is defective. Again, if you use a 110-volt lamp on a higher voltage, it will give far more light but will very soon burn out.

(Continued on page 70)

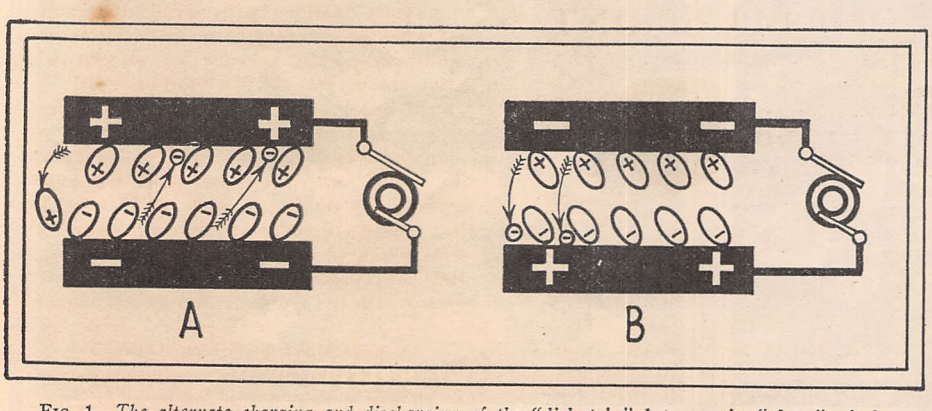


FIG. 1. *The alternate charging and discharging of the "dielectric," between the "plates" of the condenser, puts a strain on its particles. They assume one position, as at A, and are immediately wrenched around by the reversal of polarity, as at B. They break loose from time to time; and the little negative "electrons" pass occasionally from plate to plate, also doing damage. The particles indicated above are, of course, magnified billions of times.*

A Cheap, Practicable Receiver —The Crystal Set

The First Lesson in Radio Work—The Simplest Outfit the Constructor Can Build.

THERE are today many broadcast listeners, the proud owners of five- and six-tube factory-made receiving sets, who boast of having heard Chicago or even "the Coast", but have never had the real thrill of tuning-in a nearby broadcaster on a home-made crystal set.

To many listeners, a set using a crystal detector is merely a toy, something for the small boy to tinker with to keep him out of mischief. As a matter of fact, very good results are possible with a properly-designed and constructed set employing a crystal detector. In fact this type of receiver was in general use in radio receiving sets on ships and at shore stations in all parts of the world for a number of years, before the advent of the vacuum-tube detector.

At the time crystal detectors came into general use in radio, there had been employed for years a number of other methods of detection, all of which were unreliable because of their lack of sensitivity and the fact that they required constant care and attention.

MERITS OF THE CRYSTAL SET

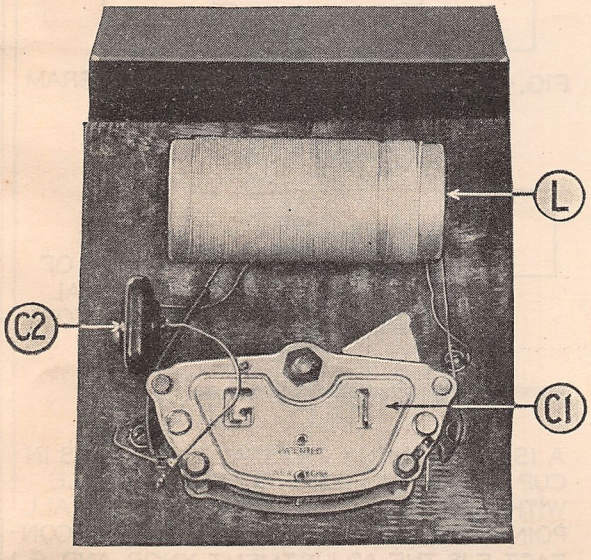
With the advent of broadcasting and the increased demand for a means of detection which would make it possible to receive signals over a greater distance than is possible with a crystal, the vacuum-tube detector was developed. Today the vacuum tube is used in most of the broadcast receiving sets in this country. In Europe and other parts of the world, however, the crystal detector is even now used in perhaps the majority of sets. There are two reasons for this: the first is that, up to a distance of fifteen or twenty miles, the crystal detector will give nearly as strong a signal as a vacuum-tube detector with none of the distortion which is often found in the latter device. Its clearness of tone has caused many good set builders to favor its use in place of a detector tube in many sets of three to five tubes, such as the well-known Interflex and Peridyne receivers. The second reason for the popularity of the crystal in foreign countries is its extreme cheapness and the fact that it operates without batteries of any kind, reducing operating expenses to a minimum.

The listener located in the immediate vicinity of the larger broadcast stations needs nothing more than the parts shown on the diagram, plus an antenna and a pair of head telephones, in order to receive by radio musical programs, weather and stock-market reports, baseball scores and other features of special interest. As stated before, this set can be used with good results up to a distance of fifteen or twenty miles from such stations with excellent results and, when an inexpensive set is required and conditions permit the use of an outdoor aerial, the crystal set fills the bill.

Such a set as described makes an ideal receiver to take to the summer cottage or camp; provided, of course, that the camp site is not located too far from the more powerful broadcast stations. It is small in size, requires little attention and, since the set is complete in itself without batteries or other heavy accessories, it can be easily carried with the regular camping equipment.

BUILDING THE RECEIVER

The parts required to assemble the set are clearly shown in the full-page diagram. The antenna coupler consists of a primary and a secondary winding, both wound with their turns *in the same direction*, on a short



This rear view of the panel of the crystal set shows how few parts are needed. The light cardboard tube L is held in place by the wires which pass from it through the panel.

FREE BLUEPRINT

No. RADIO NEWS FREE BLUE PRINT ARTICLE 57

A free blueprint of this crystal receiver will be given to anyone who will call for it at the office of RADIO NEWS; or will be mailed anywhere on receipt of a written request for it. Ask for Blueprint No. 57.

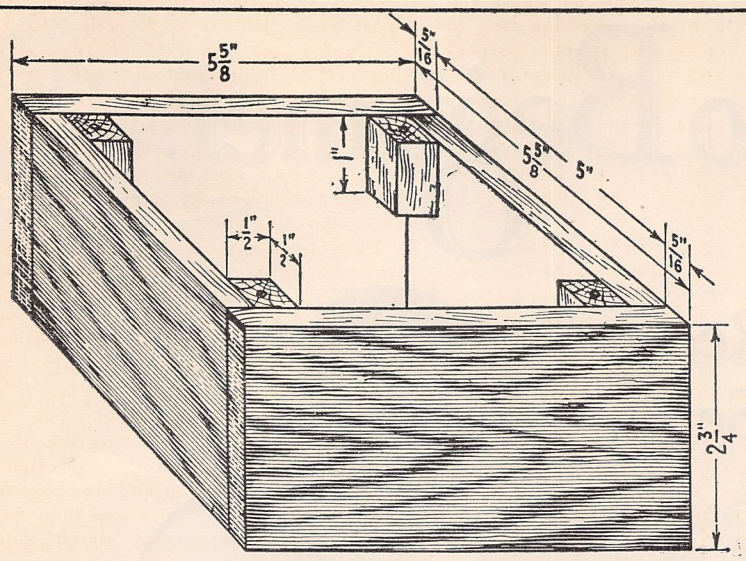


FIG. 1 - THIS DRAWING GIVES ALL NECESSARY DETAILS FOR MAKING A CABINET FOR THIS RECEIVER. WOOD CORNER POSTS 1 x 1/2 x 1/2 INCHES ARE USED TO STRENGTHEN BOX AND PROVIDE SUPPORT FOR PANEL SCREWS. THE CABINET IS MADE OF WOOD 5/16" THICK. IT IS 5 5/8" SQUARE AND 2 3/4" HIGH. IT MAY BE ASSEMBLED WITH WOOD SCREWS AND GLUE.

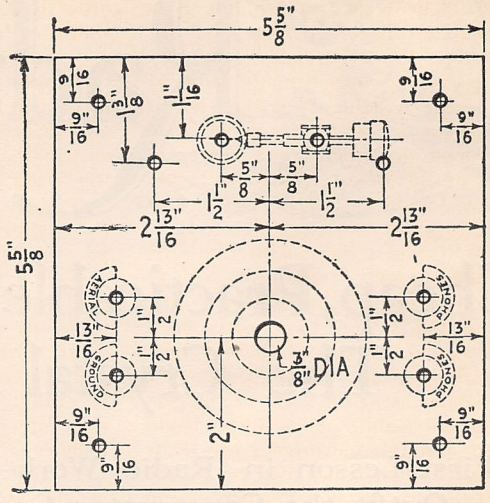


FIG. 2 - COMPLETE DRILLING LAYOUT FOR PANEL OF CRYSTAL RECEIVER. THE LOCATION OF PARTS AND BINDING POSTS IS INDICATED IN DOTTED LINES. PANEL MAY BE MADE OF CIGAR-BOX WOOD PAINTED WITH SHELLAC, OR BETTER STILL BAKELITE OR HARD RUBBER. ALL HOLES 3/16" DIA. UNLESS OTHERWISE SPECIFIED IN DRAWING.

THE CONDENSER C1 IS THE ONLY TUNING CONTROL FOR THIS RECEIVER, AND THE CRYSTAL DETECTOR IS THE ONLY OTHER ADJUSTMENT. THE AERIAL MAY BE A SINGLE WIRE 100' IN LENGTH, AND THE GROUND CONNECTION MAY BE MADE TO ANY CONVENIENT COLD-WATER OR RADIATOR PIPE. NO. 14 WIRE MAY BE USED FOR AERIAL AND GROUND WIRES. THE ONLY ACCESSORY REQUIRED FOR THE OPERATION OF THE SET IS A PAIR OF TELEPHONE RECEIVERS.

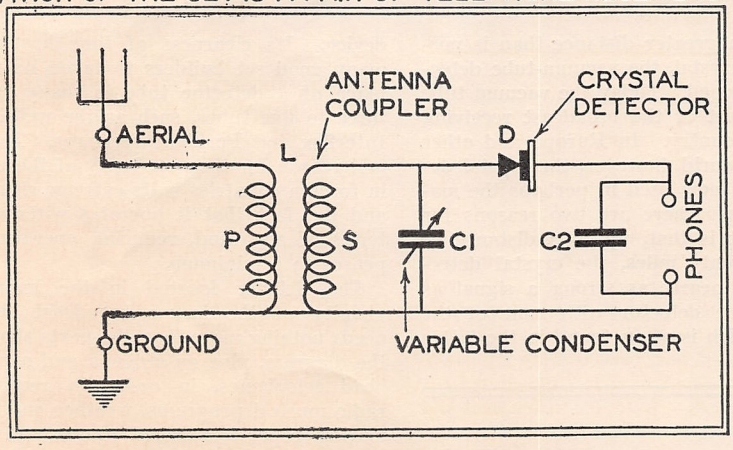


FIG. 3 - SCHEMATIC DIAGRAM OF CRYSTAL RECEIVER. L, ANTENNA COUPLER; C1, .0005-MF. VARIABLE CONDENSER; C2, .001-MF. FIXED CONDENSER; D, CRYSTAL DETECTOR.

SYMBOLS IN PICTURE WIRING DIAGRAM CORRESPOND TO SIMILARLY-MARKED PARTS SHOWN SCHEMATICALLY IN WIRING DIAGRAM. NO. 24 D.C.C. WIRE MAY BE USED FOR MAKING CONNECTIONS, AND ALL JOINTS SHOULD BE SOLDERED FOR BEST RESULTS.

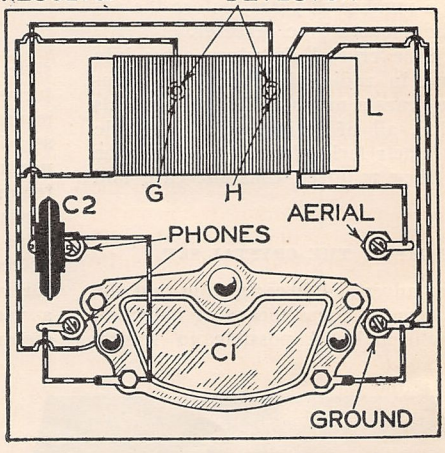
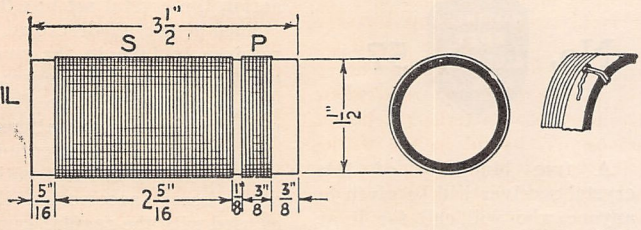


FIG. 4 - COMPLETE PICTURE WIRING DIAGRAM

FIG. 5 - DETAIL OF COIL L



SECONDARY COIL (S) CONSISTS OF 90 TURNS NO. 24 D.C.C. WIRE ON 1 1/2" DIA. CARDBOARD TUBE. PRIMARY COIL (P) HAS 15 TURNS OF SAME SIZE WIRE ON SAME TUBE. A STANDARD MAILING TUBE MAY BE USED FOR COIL FORM.

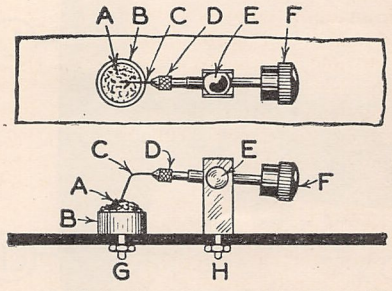


FIG. 6 DETAIL OF CRYSTAL DETECTOR

A IS THE GALENA CRYSTAL WHICH FITS IN CUP B. CATWHISKER C IS HELD IN PLACE WITH CHUCK D. BALL JOINT E MAKES ALL POINTS ON CRYSTAL ACCESSIBLE FOR CONTACT. F IS THE ADJUSTMENT KNOB AND G. AND H ARE TERMINALS.

length of cardboard mailing tube or other suitable coil form, one and one half inches in diameter. The secondary winding S is started five-sixteenths of an inch from the end of the tube. Two small holes about one-half inch apart are punched in the tube, at the start of the winding, and the end of the wire is passed down through one hole and up through the other. This serves to tie the end of the wire. About six inches of extra wire should be left at the start of the winding to serve as a connection. Having securely anchored the end of the wire, you may wind ninety turns (of No. 24 double-cotton-covered wire) firmly and smoothly on the tube. Two more small holes are made at the end of this winding, and the wire is passed through them, in the same manner as at the start of the coil. A space of one-eighth of an inch should then be left and two more holes are made in the tube, through which can be passed the start of the primary coil P. This should consist of fifteen turns of the same wire, wound in the same direction as the secondary. A short length of wire should be left at the start and finish of this winding also, for connection to the other parts of the set.

OTHER PARTS

The most expensive part required in the construction of the set is the variable condenser. This should have a capacity of .0005-mf. and should be of "low-loss" type; that is, have good insulating material, not too large, and be of substantial construction. Any fixed condenser of good quality may be used for the phone condenser; however, the one selected should have a capacity of at least .001-mf.

The other parts required to assemble the set are four binding posts, a few short lengths of wire for connections and the detector device. The detector shown in the illustration uses a galena crystal, but silicon can be employed with results nearly as good. The galena crystal is the more sensitive of the two but requires a little more care in adjustment than does a silicon crystal. The crystal used may be purchased in either the mounted or unmounted form. The mounted crystal is shown in the illustration; this will give the best results and costs but little more than in the unmounted form. In handling the crystal care should be taken to protect it from dust and moisture and *it should be handled as little as possible.* The surface of the crystal should never be touched with the fingers if this can be avoided, as the oil from the skin tends to make the crystal less sensitive.

The layout for the panel is given in Fig. 2, the location of the parts and binding posts being indicated by the dotted lines. The panel may be made of cigar-box wood or, better still, of bakelite or hard rubber. A plain three-inch dial is required, and should be securely fastened to the shaft of the variable condenser after the condenser is mounted on the panel. This is the only tuning control for this receiver.

THE ANTENNA SYSTEM

The aerial may be a single length of No. 14 bare copper wire and, if possible, it should be 100 feet in length; although this can be changed slightly to fit local conditions. The aerial may be strung between two convenient trees, the roof of the house and a near-by tree, or any other suitable support. An insulator is required for each end of the aerial. The *lead-in,* from the aerial to the receiving set, should be securely soldered to the end of the aerial which is nearest to the receiving set, in order to make the lead-in as short as possible; or, better still, a single piece of wire may be used for both aerial and lead-in. Care should be taken to see that the lead-in is carefully insulated from all objects with which it might come in contact, such as window sills, gutter pipes or the side of the house.

If the receiving set is to be located in the city, an excellent ground connection may be secured by fastening a ground-clamp around a convenient water or steam pipe, first making sure that the connection is free of paint, scale, etc.; so that good metallic contact will be obtained between the pipe and the clamp. If no water or steam pipe is available it will be necessary to make some other kind of ground connection. A number of short lengths of pipe, three or four feet each, may be driven into the ground at a convenient point and all connected together by a wire leading from them to the "ground" binding post on the receiving set.

THE LIGHTNING ARRESTOR

If the set is to be installed permanently at your home or cottage it will be well to install some form of approved *lightning arrestor.* This should be mounted on the outside of the house at a point just above where the lead-in enters the wall. The lead-in wire is then brought to the top of the arrestor and from there to the aerial binding post on the receiving set. The lower connection on the arrestor should then be connected with the ground.

ADVICE TO PARENTS

IF that boy is interested in radio, a good way to keep him out of mischief is to start him in where his old man started—building his own. This little set costs little or nothing, and will bring in the locals—and it will give the young constructor an insight into doing things for himself.

The success of this type of receiving set depends to a great extent upon the aerial and ground and the crystal detector. The higher the aerial the better, provided that the lead-in does not exceed fifty or sixty feet. If the ground lead is connected to a water pipe and care is taken to see that the pipe is well scraped before the ground clamp is applied, the ground connection should be about as good as is necessary for the average receiving set.

ACCESSORIES

The only "accessories" required for this set are a pair of headphones, which may be purchased at from two dollars up to, say, ten dollars. A good pair will be found an excellent investment for the experimenter; as they can be used with larger sets, when built, for "distance work" in radio reception, and are, furthermore, useful in the workshop for testing radio parts (with the aid of a small battery). It is therefore advisable to get as good a pair as you can afford, as it will add considerably to the satisfaction obtained from all future radio work. As the energy in the circuit of the crystal detector is small at the best (unless you are very close to a station) the sensitivity of the phones is important; they should be of a resistance of 2,000 to 4,000 ohms.

The only part which should need occasional replacement is the crystal, which costs but a few cents and should last a long time. There is a great difference between crystals—as there is, in the sensitivity, between different points on the same crystal. It is advisable to purchase only "tested" crystals, which cost but a little more than the general run of specimens, and are well worth the difference.

There are many different kinds of minerals beside galena and silicon which give the detecting action of the crystal, and, when radio was younger, experimenters spent much time working with different combinations. The builder of this set, if he is where strong signals may be heard, may derive considerable amusement from a little work of this kind. The detection, it may be explained, is due to the fact that the current in the crystal circuit can pass much more freely in one direction than in the other; and the alternating "signal" wave is thus converted into the small direct current needed to work the diaphragms of the telephone receivers. This action may be obtained between two fine points of any conductor which touch each other over a very small area; but such apparatus is generally of too delicate a nature to be undertaken in the home. Detection between two steel balls, and other metal surfaces, was described in RADIO NEWS for September, 1927 ("Rectifying with Metallic Detectors") and old-timers in radio will remember many very interesting devices with which they used to tinker—such as platinum wire and mercury, razor blades and carbon rods, etc. The set builder of today, however, will hardly go so far into experimental work.

OPERATION IS EASY

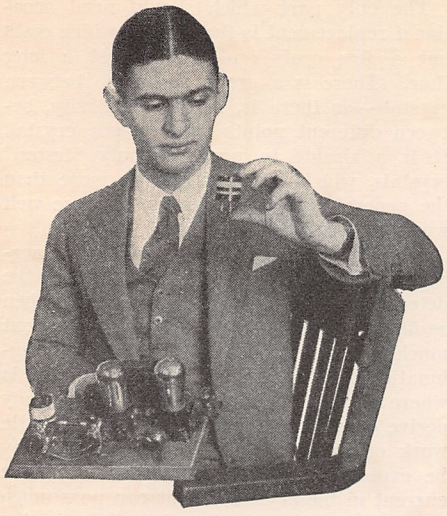
When the receiving set has been completed and all necessary connections made, including the aerial and ground, the knob F which adjusts the *catwhisker* should be so placed that the end of the spring wire C rests lightly upon the surface A of the crystal. (See Fig. 6.) The variable condenser should then be turned slowly back and forth from one end of the scale to the other until a station is heard. If no station is tuned-in, and you are sure that a station in your vicinity is broadcasting at the time you are listening, the catwhisker on the detector should be readjusted and the condenser turned as before. At first it may be necessary to repeat this operation several times until the operator locates a sensitive spot on the crystal. After having located the most sensitive spot on the surface of the crystal, the operator can usually readjust the detector from day to day with but little trouble. Patience, of course, will at many times be needed.

In the crystal sets sold extensively in Europe, the detector is often furnished in a glass tube, or other cover to protect it from dust, moisture and disturbance. The builder of this set is not apt to go to so much trouble; as before long, probably, he will consider the two-tube "Extension" receiver described in this department in the May issue of RADIO NEWS, or some similar set, on which to exercise his ingenuity. However, should this set remain in use for any reason, it will perhaps be found necessary to clean the crystal. Alcohol or some similar fluid which will evaporate completely should be used; and the crystal, as we said before, should not be handled with the bare fingers or anything oily.

A "Junk Box" Short-Wave Receiver*

For the Experimenter Who Wishes to Try His Luck Below a Hundred Meters

By Robert Hertzberg



BECAUSE of the extraordinary DX work that is being accomplished by amateurs and broadcasters on the short waves (*i.e.*, below 100 meters), many radio fans have become possessed of the idea that the apparatus used for such reception must necessarily be complicated, expensive, and difficult to construct and operate. These fans read of the success of listeners in South America, Africa, Australia and New Zealand in picking up programs transmitted on short wavelengths from Schenectady and Pittsburgh in the United States, and from London, in England; and of the similar success of American listeners in hearing broadcasts from England, Holland, Germany, Russia, Siberia and Australia. As a result, they are apt to conclude that the receivers must contain at least eleven tubes and be two yards long.

The truth of the matter is that the receivers employed by the majority of these listeners are of the simplest possible design, rarely containing more than three tubes and usually only two. They are of the "straight regenerative" type, and can be made in an hour or so of spare parts, such as are found in every experimenter's junk box. They enable their owners to pick up the programs of numerous short-wave broadcast stations, conversations between amateurs using voice transmission, and code signals from thousands of amateur and commercial transmitting stations in every part of the world. The "thousands" is no exaggeration; for there are more than 16,000 licensed amateur transmitting stations in the United States alone, and large numbers in other countries. International communication between these stations, over distances as great as there can be between two points on this earth, is a nightly affair.

OUT OF THE JUNK BOX

For the purpose of illustrating how simple an efficient short-wave receiver can be, a member of the staff of Radio News selected a handful of idle parts from his own private junk box and assembled a complete two-tube set in less than two hours' time. He worked a second evening "juggling" the various coils, to make them cover the short-wave bands from 20 to 100 meters, but the reader of this article will be spared this work; all the data are ready for him. The little outfit produced such gratifying results that Radio News decided to publish the following description of it. The designer of the set guarantees that any reader who duplicates it exactly will be rewarded with more thrills than he has experienced from any other radio receiver in several years.

FEATURES OF THIS SET

THE little short-wave receiver described in the accompanying article possesses the following features, which will appeal to everyone:

(1) *It will pick up short-wave broadcast, amateur and commercial stations operating between* 20 *and* 100 *meters.*

(2) *It may be assembled in two hours.*

(3) *Its cost is practically nothing; as the necessary parts may be found in almost every experimenter's junk box.*

(4) *It is easily operated, as it uses only two controls and two tubes in a simple circuit.*

The first thing to do, of course, is to gather together the necessary parts. You will need the following:

One wooden baseboard, not smaller than 10¼ by 7 inches and at least ¾-inch thick.
Three UX-type tube sockets.
Two 32-mmf. "midget" variable condensers (so-called "verniers" usually used in broadcast receivers for neutralizing or compensating purposes), C1 and C2.
One .0001-mf. grid condenser and a 3-megohm leak, (a regular .00025-mf. size will work, but the smaller condenser is better on the short waves); C4, R1.
One battery switch, SW.
One R.F. choke coil. (This is important; if you haven't a good one on hand, buy one that will work from 20 meters up); L2.
One A.F. amplifying transformer (anything available); T1.
Two ¼-ampere filament ballast resistors, with mountings; R2, R3.
Nine spring binding posts.
Five burned-out tubes with UX-type bases.
Enough scrap brass to make L-shaped mountings for the two midget condensers and the battery switch and for the aerial coupling condenser, C3.

CONSTRUCTION SIMPLE

The first thing to do is to make the L-shaped brackets to hold the midget condensers and the battery switch upright. Select any odd strips of stiff brass, about ⅝-inch wide, and bend three pieces to form L's about two inches high, with legs half an inch long. Drill the legs to pass small wood screws, and the upper ends to pass the mounting studs of the condensers and the switch. Screw them down along the front edge of the baseboard, as shown clearly in the accompanying illustration, and mount the instruments afterward.

Now nail or screw down seven of the spring binding posts along the back edge of the board, and the remaining two on the right edge, near the back. Continue by screwing down the R.F. choke L2, the transformer T1, the filament ballasts R2 and R3, and the three tube sockets. Separate the two sockets on the left enough to leave room for the grid condenser.

The two sockets at the right are for tubes, but the one at the left acts as a receptacle for the plug-in coils used with the receiver. Before making up these coils, construct the aerial coupling condenser C3, as shown in an accompanying illustration. This condenser has a very small capacity, and its adjustment is not at all critical. Any arrangement for separating two pieces of brass or copper each one-half inch square is satisfactory.

Break the glass bulbs off the five burnt-out tubes, and clean the insides of the bases, removing the connecting wires, bulb stems and cement. If the cement defies removal by ordinary scraping, heat the bases gently over a gas flame and scrape it out as it softens. Apply a soldering iron to the prongs in the bases and melt out all the solder so that new connecting wires may be pulled through latter. If the solder refuses to flow out, push a toothpick through each pin while the metal is still soft, and ream the opening clean. Also file off the little bayonet-lock pins on the sides of the bases.

MAKING THE PLUG-IN COILS

In order to provide the receiver with a wavelength range of 20 to 110 meters, five plug-in coils, each containing a grid and a tickler winding, are necessary. The tube bases are long enough to accommodate the required number of turns of wire for the first four coils; but the fifth base must be fitted with an extension that will make it about three inches long. Simply glue a piece of cardboard around the base and tie it up with cord until it dries. When the wire is wound on it later it will remain tightly in place.

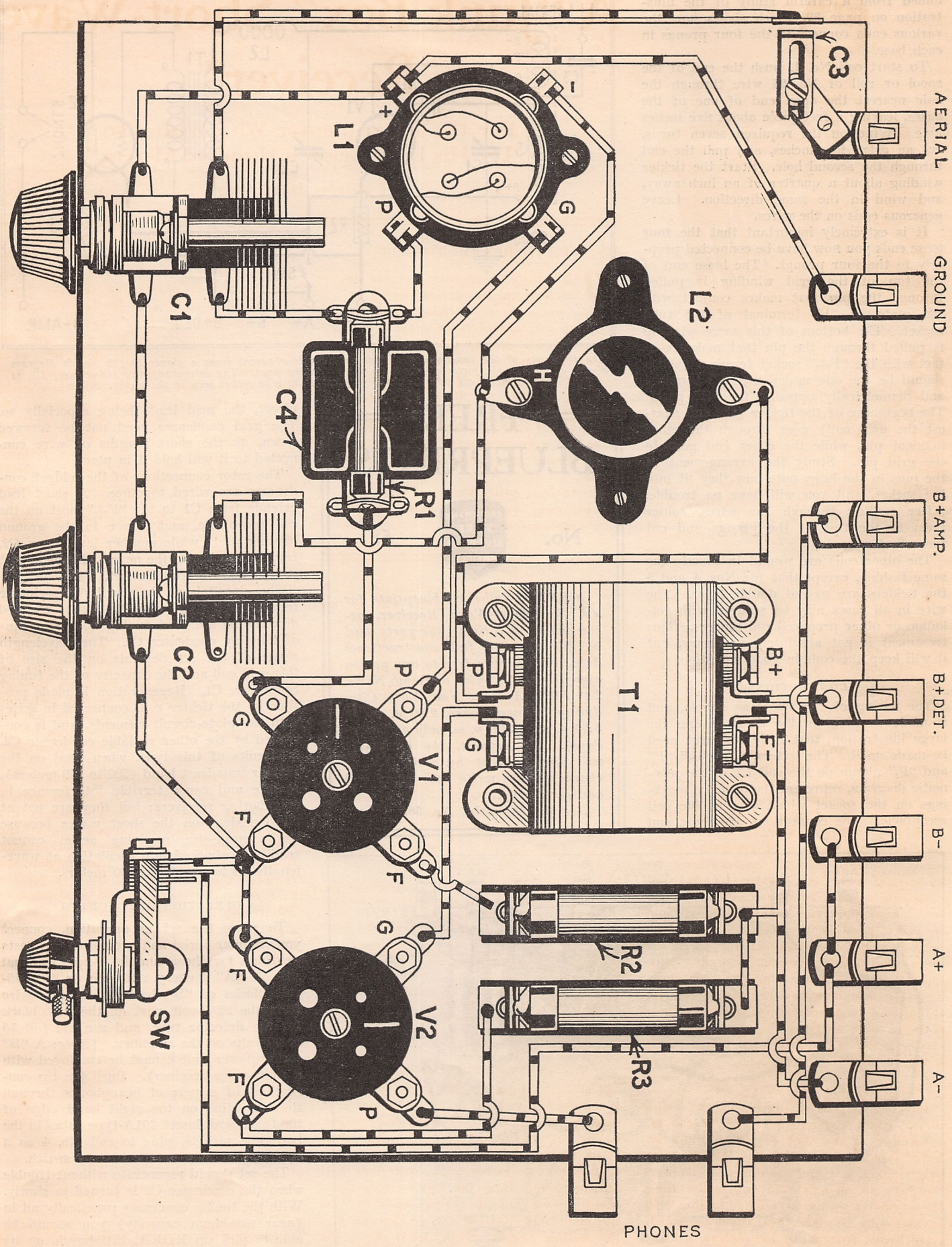
Following are the specifications of the five coils:

No. 1: Grid and tickler windings, each 7 turns; wavelength range, approximately 19 to 25 meters.
No. 2: Grid and tickler windings, each 10 turns; range, 25 to 35 meters.
No. 3: Grid and tickler windings, each 15 turns; range, 35 to 45 meters.
No. 4: Grid and tickler windings, each 22 turns; range 45 to 64 meters. Tickler wound as double layer to save space.
No. 5: Grid and tickler windings. each 40 turns; range, 62 to 110 meters. Tickler also double-layer.

The grid coils are all wound with No. 24 D.C.C. wire, and the ticklers with No. 28 D.C.C.

Before starting to wind the coils, drill through each of the bases four small holes to pass the ends of the windings. The

* Radio News *Free Blueprint Article No.* 58. *See page* 38.



The connections of the "junk-box" short-wave receiver are shown here in straight lines for clearness; but in the set itself, as the picture on page 38 shows, they are run as short and direct as possible—especially the aerial and detector leads carrying R.F. energy, because of the high capacitive transfer of energy at ultra-high frequencies. The constructor, bearing in mind this rule, may depart from the layout here as the apparatus he has at hand suggests.

proper places for these holes can be determined from a careful study of the illustration on page 39, which shows how the various ends connect to the four prongs in each base.

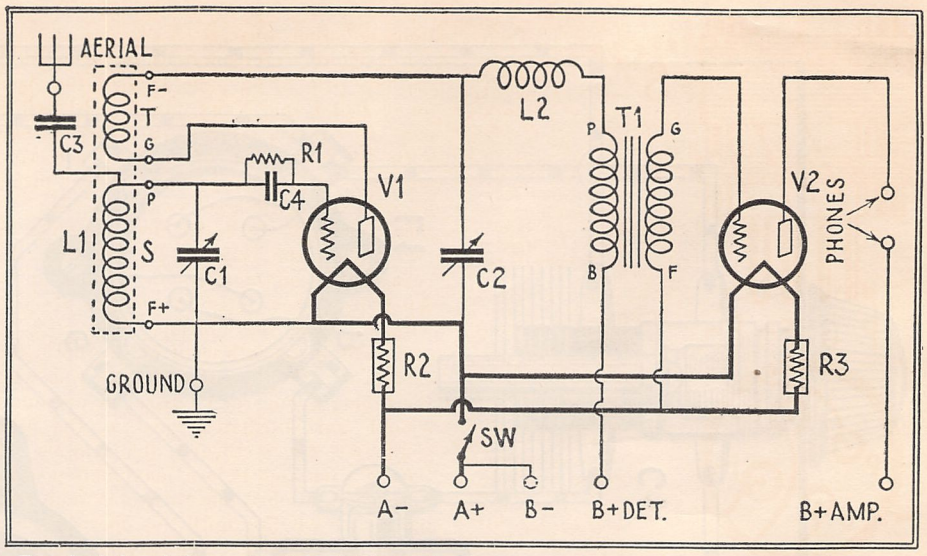
To start coil No. 1, push the end of the spool or roll of No. 24 wire through the hole nearest the open end of one of the bases, leaving a free piece about five inches long. Wind on the required seven turns, cut an extra five inches, and pull the end through the second hole. Start the tickler winding about a quarter of an inch away, and wind in the same direction. Leave generous ends on the wires.

It is extremely important that the four loose ends you now have be connected properly to the four prongs. The loose end of the top of the grid winding is pulled through the pin that makes contact with the plate or "P" terminal of the tube socket. The bottom of this same winding is pulled through the pin that makes contact with the "F+" socket terminal (which should be the one under the "P" terminal and diametrically opposite the "G" post). The beginning of the tickler (the end nearest the grid coil) goes through the other filament pin, while the other end goes to the grid pin. Study the arrangement of the pins in the base, note how they fit into the socket, and you will have no trouble. After pulling through the wires, solder them at the tips of the prongs and cut them flush.

The other coils are wound in exactly the same fashion, except that for Nos. 4 and 5 the ticklers are wound double layer. The wire in all cases may be secured with collodion or other prepared coil binders. This treatment is not absolutely necessary, but it will keep the coils in good condition.

CONNECTIONS

The wiring of the set is so simple, and is made so plain in the diagram and the large illustration, that little comment need be made on it. The letters, "F," "G," "P" and "F," alongside the coil L1 in the schematic diagram, represent the terminal markings on the socket which acts as the coil receptacle. The connections are short and direct, the grid leads being especially so. The grid condenser need not be screwed down, as the short lengths of wire connected to it will hold it in place.



The simplicity of the construction of this receiver is apparent from a glance at the circuit diagram above, as well as the pictorial layout on the preceding page. The interchangeable inductance, L1, is wound on an old tube-base, and plugs into the tube socket seen in the picture below.

FREE BLUEPRINTS

No. RADIO NEWS FREE BLUE PRINT ARTICLE 58

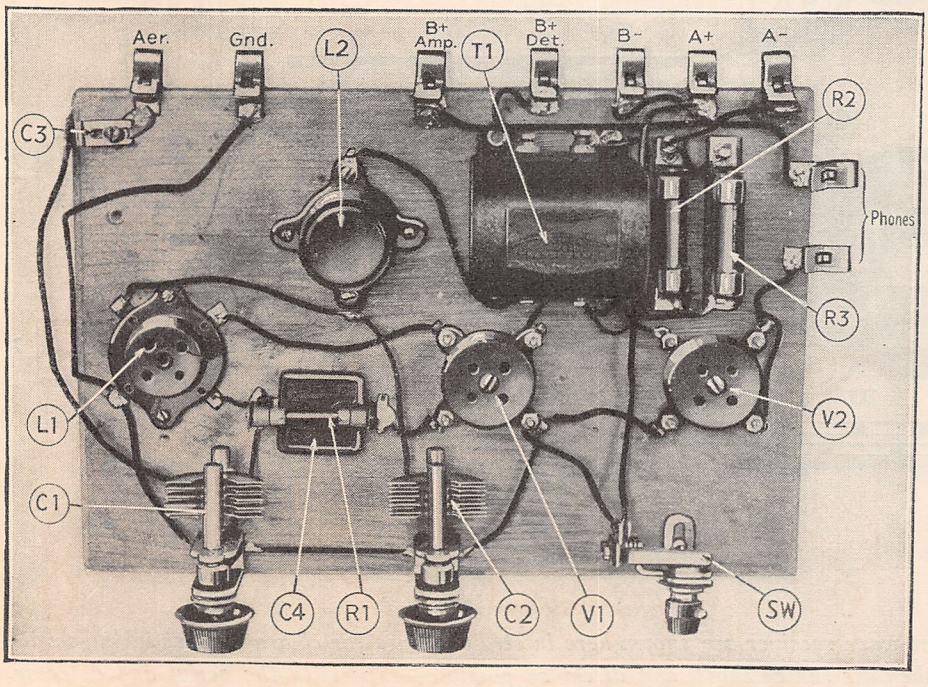
A SET of full-sized blueprints for this Short-Wave Receiver, accompanied by a list of the parts used in this set and full constructional data, will be given free to any person applying at the office of Radio News, *230 Fifth Avenue, New York City, during business hours, 9:00 a. m. to 5:30 p. m. (1:00 p. m. only on Saturdays). On request, the blueprints will also be sent by mail free of charge; please write your name and address clearly.*

Ask for Blueprint No. 58.

The rotor connections of the midget condensers are wired together. A short lead extends from C1 to the "F+" post on the coil receptacle, and thence to the ground binding post; while another lead, from C2, runs two inches to the nearest filament post on the detector-tube socket, V1.

The circuit is of the simplest imaginable regenerative type, with the aerial coupled directly to the grid tuning coil by means of the tiny condenser C3. The wavelength range of the set depends on the size of this grid coil and the capacity of the tuning condenser, C1. Regeneration is made possible by the tickler coil, connected in series with the plate-circuit elements, and is controlled by the other variable condenser C2.

Circuits of this type, when used on the regular broadcast band (200 to 550 meters), radiate and cause terrible interference in neighboring receivers; but they are not at all obnoxious on the short waves because the average-size receiving aerial cannot readily be shocked into oscillation at wavelengths as low as 20 to 100 meters.

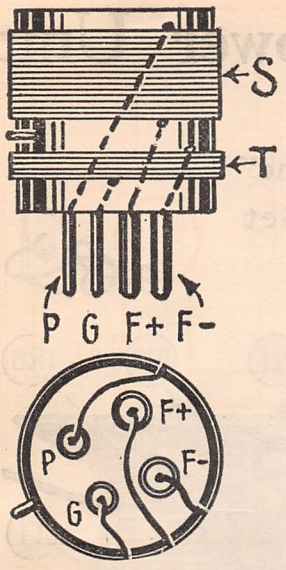


All the connections employed in this set are made on top of the wooden baseboard, as may be seen in the illustration. The capacity, C3, is shown in detail on the following page; it consists of two separately-movable metal plates.

OPERATION AND TUNING

To place the set in operation, connect your regular aerial and ground to the posts provided for them, and hook-up the usual six-volt "A" battery and one or two 45-volt blocks of "B" battery. Run a wire from the 22½-volt post on the first block for the detector tube, and use the full 45 or 90 volts on the amplifier. (*Note*: A "B" socket-power unit cannot be employed with a short-wave receiver). Push the tip connections of a pair of headphones through the two clips on the right hand edge of the baseboard, insert 201A-type tubes in the two tube sockets, plug in coil No. 4 as a starter, and snap on the battery switch.

The set should regenerate without trouble when the condenser C2 is turned in slowly. With the tuning condenser practically all in (near maximum capacity) you should be able to pick up KDKA, Pittsburgh, on its 62.5-meter wave. (This station has what is probably the most consistent short-wave broadcast transmitter in the world.) You should hear it also on coil No. 5 with the condenser all out (minimum capacity). With coil No. 4 you should also pick up,



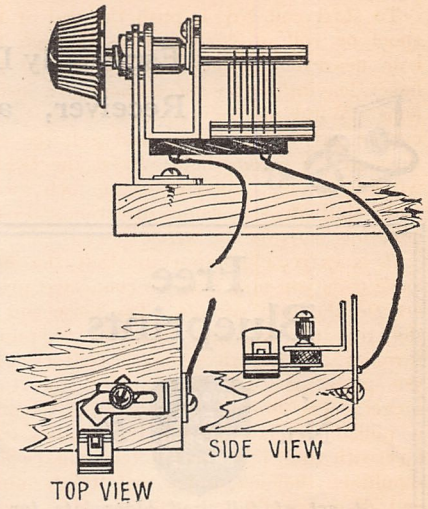
The details of one of the plug-in coils used in the "junk-box" short-wave receiver, which is built up on the base of a burnt-out UX-type tube. This is large enough to give room for the tickler winding T and the aerial-secondary S, of suitable size to be tuned by a 32-mmf. condenser (C1) up to 64 meters. Above this it is necessary to add a cardboard extension to the base to increase its height. Details for the five sizes of coils will be found on the first page of this article. The connections, shown in plan at the bottom, are as follows: top of grid winding to "P" prong; bottom of grid winding to "F+"; top of tickler (T) to "F—"; bottom of tickler to "G."

without delay, the signals of WLW, on 52 meters. With coil No. 2 and most of the condenser in, WGY, on 32.77 meters, should roll in nicely. Once you hear these stations you will have some definite condenser adjustments to rely on in "fishing" for stations on other waves.

For handy reference, cut out the list of stations printed on page 1175 of the April number of RADIO NEWS, and those listed on page 60 of this issue. All these stations, with the exception of a few, use voice transmission regularly, and can be picked up with this little receiver if you "fish" for them carefully and learn how to adjust the two midget condensers. By the way, disregard the coil numbers mentioned in the April list; they refer to another receiver, with but three sets of coils.

To obtain smooth control of the regeneration is a simple matter. Each coil, when the tuning condenser C1 is set at maximum, should start oscillating just as the other condenser, C2, is turned to maximum. If the set oscillates before maximum position is reached, remove one turn at a time from the tickler winding until this operating condition is attained. The ticklers specified earlier in this article will probably be found too big, and will produce oscillation with only part of the regeneration condenser in use; but they are purposely designed large, because they can be cut down very easily to suit the operating characteristics of different tubes.

The best adjustment for the aerial condenser C3 must be found by trial; it will depend on the dimensions of the individual aerial. Likewise, different values of the grid leak should be tried.



Above, a side view of the midget tuning condenser C1. One lead runs to the top of the grid winding S and to the aerial condenser C3, formed by the small adjustable plates shown in the top and side views. Its adjustment for the aerial used must be determined by experiment. The two opposed surfaces are about one-half inch square.

A. C. Tubes Require Special Wiring Care

ONE of the most troublesome causes of "hum" in a receiver which employs A.C. tubes is interstage coupling in the parts of the circuit which are common to both R.F. and detector circuits.

When the location of the parts of the set is properly planned, and the wiring carefully arranged and cabled to avoid coupling effects, no trouble may be expected from "hum." In many cases, however, the limitations of space and the necessity for crowding parts together will introduce "loops" and coupling effects in the wiring.

The use of the grid-condenser-and-leak arrangement for the detector, while highly efficient and sensitive, very often makes the field surrounding the detector portion of the receiver very critical and unstable. If any trouble is experienced from that source, it is usually best to change the detector to the grid-bias method.

A SIMPLE FILTER

In the event that this change does not eliminate the coupling which causes "hum," a simple method which is practically a sure-fire cure is to insert a 0.1-megohm (100,000-ohm) fixed resistor in the grid-return lead between the "F" terminal of the R.F. transformer secondary of the detector circuit and the grid-biasing resistor which provides the bias for the R.F. and detector circuits. A 0.1-mf. by-pass condenser should then be connected between the "F" terminal of the transformer mentioned and the cathode terminal of the detector tube. (See Fig. 1.)

Another precaution to keep the hum down to an absolute minimum when using a 227-type A.C. tube as a detector is to connect the center-tap of its 2½-volt filament-supply transformer winding to the "B+ Det" tap; thus placing a bias of from 22½ to 45 volts between the heater filament and the cathode. (See Fig. 2.)

The 227-type A.C. tube is very free from microphonic action and does not require the special treatment or mounting usually necessary in the case of microphonic detector tubes.

LARGER WIRE NEEDED

One of the most important things to watch, when using the new A.C. tubes of the 226 and 227 types, is to make sure that the wire used for the connections to the filaments is heavy enough to carry the required current.

In using tubes of the 201A, 112A, 171A,

(*Continued on page 69*)

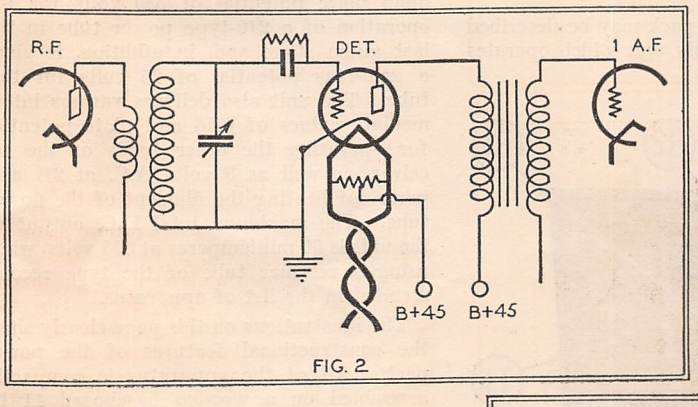


FIG. 2

In Fig. 2, at the left, the heater filament is 45 volts positive with regard to the cathode, from which it is electrically insulated; this is one way to minimize the transfer of current hum to the cathode. In Fig. 1 are the connections mentioned in the text. Terminal Y may be connected to either W or X; trial will show which provides the best results. D is the R.F. grid-biasing resistor, often a 400-ohm potentiometer; A and B the R.F. and detector filament center taps.

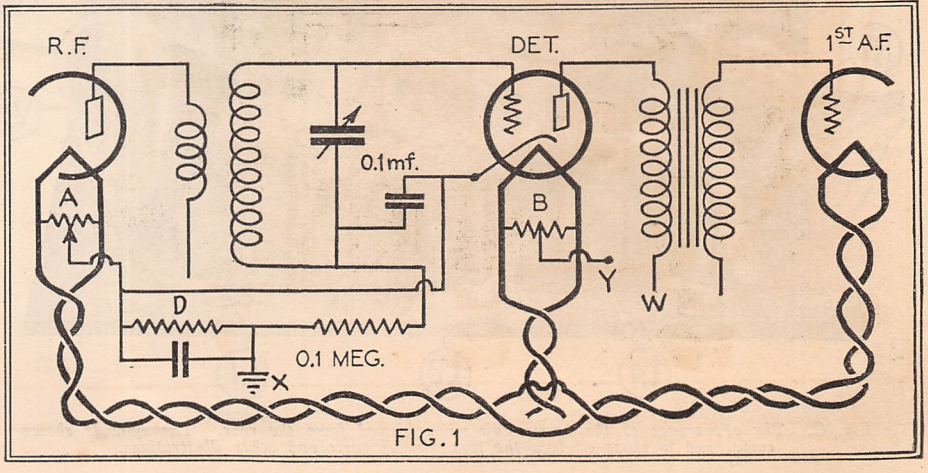


FIG. 1

A Sturdy and Dependable "B" Power Unit

Especially Designed for Use with the "Neutroheterodyne" Receiver, and Readily Adaptable to Any Large Set

Free Blueprints

No. RADIO NEWS FREE BLUE PRINT ARTICLE 59

A set of full-sized blueprints for this "B" and "C" power-supply unit, accompanied by a list of the parts used in this device and full constructional information, will be given free to any person applying at the office of Radio News, 230 *Fifth Ave., New York City, during business hours, 9:00 a. m. to 5:30 p. m. (1:00 p. m. only on Saturdays). The blueprints will also be sent by mail free of charge; please write or print your name and address clearly, as signatures are often illegible.*

Ask for Blueprint No. 59 for the Neutroheterodyne power unit.

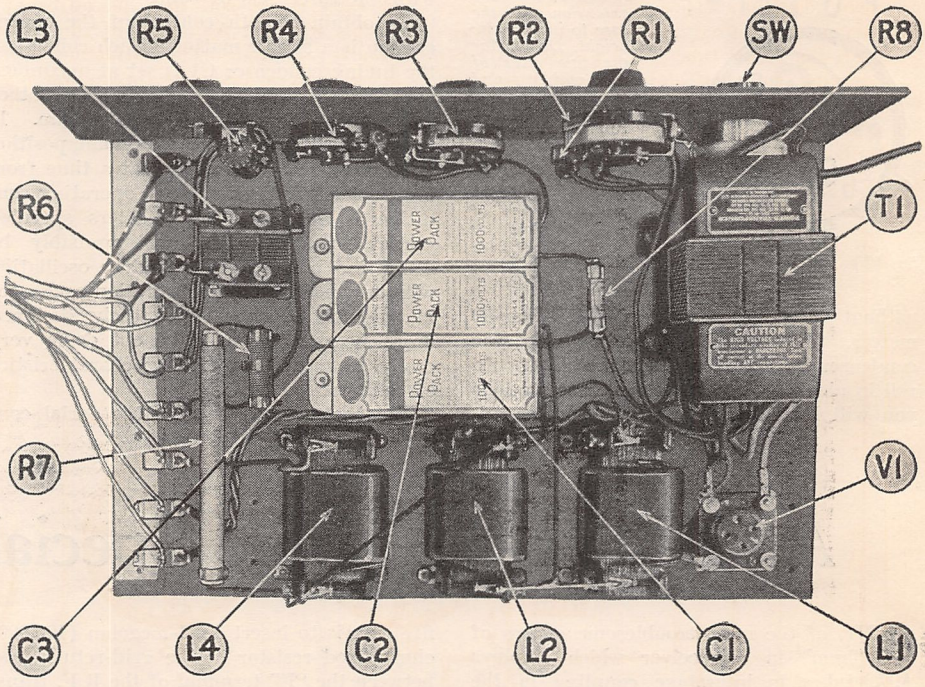


Fig. B. The exact position of all parts mounted on the baseboard is shown in this top view of the power unit. T1, power transformer; V1, tube socket; L1 and L2, filter-choke coils; L3, detector "B" choke coil; L4, output choke coil; C1, C2 and C3, filter condensers; R6, R7 and R8, fixed resistors; R1, R2, rheostats; R3, R4, grid-bias resistors; R5, "B+Det." control.

THE "B" socket-power unit described in this article was designed especially for use with the seven-tube Neutroheterodyne receiver, which was described on page 1336 in the June 1928 issue of Radio News. However, its designer was careful to make the apparatus as flexible as possible; therefore, it may be used satisfactorily with most large receivers of similar design.

Briefly, this power pack may be described as a "B and C" supply unit which operates directly from any standard 110-volt, 60-cycle source of power. It provides a maximum plate potential of 350 volts for the operation of a 210-type power tube in the last audio stage and, in addition, it gives a grid-bias potential of 25 volts for this tube. The unit also delivers various intermediate values of grid and plate potential for operating the other tubes of the receiver, as well as 8 volts A.C. at 2½ amperes for heating the filament of the power tube. The maximum total D.C. output of the unit is 60 milliamperes at 375 volts, when using a rectifier tube of the type recommended in the list of apparatus.

The illustrations on this page clearly show the constructional features of the power pack. All of the apparatus is compactly assembled on a wooden baseboard 11 by 17 inches, and the controls are mounted on a vertical bakelite panel 7 by 18 inches. It will fit easily into any console base.

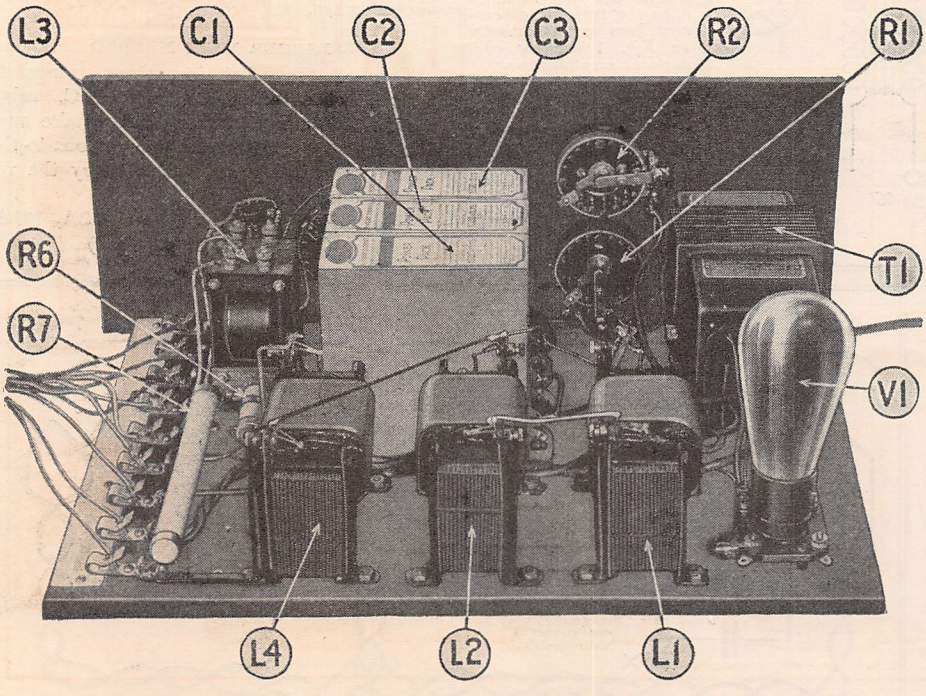


Fig. C. The appearance of the power unit when viewed from the rear. The symbols shown correspond to those used in the text, list of parts and other illustrations.

CHARACTERISTICS

In circuit design the power unit under discussion is not unusual, but several interesting features have been incorporated in the wiring. From the diagram it may be seen that the power is supplied by a single power transformer with three secondary windings. One of the latter provides the high voltage for the rectifier, and the other two windings are center-tapped and each has an output of 8 volts at 2.5 amperes; one is used for heating the filament of the power tube and the other for the rectifier.

The builder of this unit has a choice of rectifier tubes. The unit was originally designed for operation with a tube of the 216B type, but it may also be used in connection with the new 281-type rectifier. When the 216B-type tube is used the output voltages shown in the diagram are obtained; the voltages obtained from the 281-type tube are slightly higher, but the increase is not sufficient to make necessary any other changes in the unit. Both the 216B- and 281-type tubes are half-wave rectifiers and each requires the same filament current. Therefore, in most cases they may be used interchangeably. However, the latter tube has a greater current-carrying capacity and a lower resistance, with the result that it is possible to obtain a greater output under the same conditions without overloading.

The filter circuit of the power unit is standard. It employs two A.F. choke coils connected in series and three filter condensers connected at various points across the line. The two audio-choke coils of the filter circuit have a total resistance of 1,200 ohms, a maximum current-carrying capacity of 60 milliamperes and a maximum inducttance of 50 henries each. The chokes have another feature which makes possible highest efficiency; namely, *an adjustable air gap in the core.* After the power unit has been connected to the receiver the air gap of each choke coil may be adjusted and in this way the A.C. hum of the output is greatly reduced. The adjustment of the air gap gives the choke the highest possible inductance under any operating conditions. The three condensers used in the filter circuit are units of 4 mf. each.

SPECIAL CHOKES INCLUDED

An interesting feature of the power unit is that the loud-speaker filter coil is mounted in the power unit rather than in the receiver. This piece of apparatus operates with equal efficiency in this position, and in this way it is possible to remove a large and heavy piece of apparatus from the receiver. The 4-mf. by-pass condenser, which together with this audio choke coil comprises the loud-speaker or output filter, is mounted in the receiver cabinet. Another piece of apparatus mounted in the power pack is the choke coil connected in the plate lead of the first-detector tube (see the previous Neutroheterodyne article); this coil is not needed with all types of receivers, but is required for the operation of a superheterodyne of the type this power unit was designed to supply.

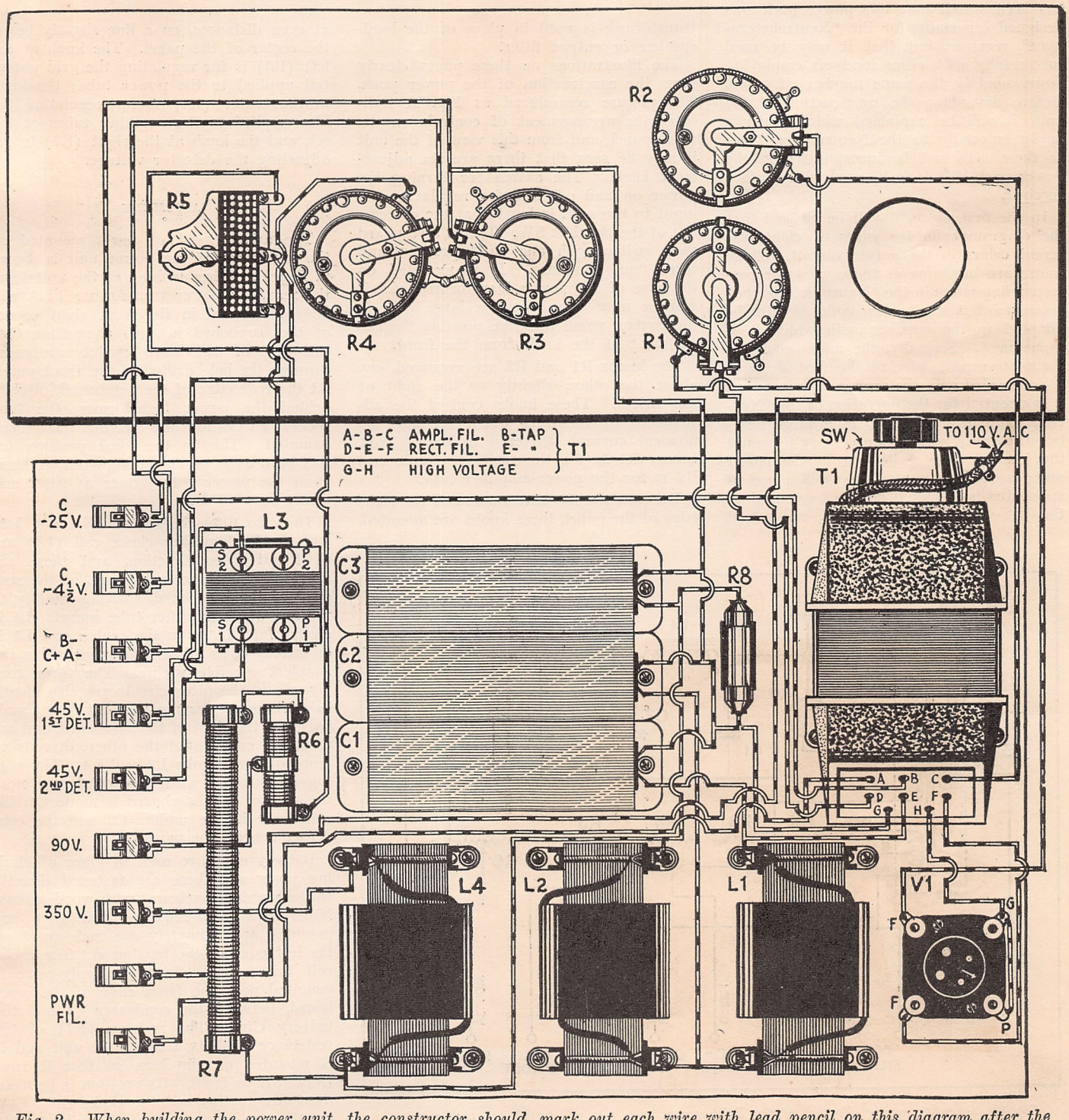


Fig. 2. When building the power unit, the constructor should mark out each wire with lead pencil on this diagram after the connection has been completed, thus insuring greater accuracy in wiring.

VARIABLE VOLTAGES

In the resistance bank of the voltage-dividing potentiometer, both fixed and variable units are employed. Two fixed resistors connected in series are employed to reduce the potential from 350 volts to 90 volts, the value required for the operation of the amplifier tubes of the receiver. The resistor which causes the potential to drop to 45 volts for the operation of the two detector tubes is a variable unit; and two other variable resistors are employed for obtaining the two values of grid bias which are required. In addition to these two resistors, two rheostats are used to control the filament voltages of the rectifier and power-amplifier tubes.

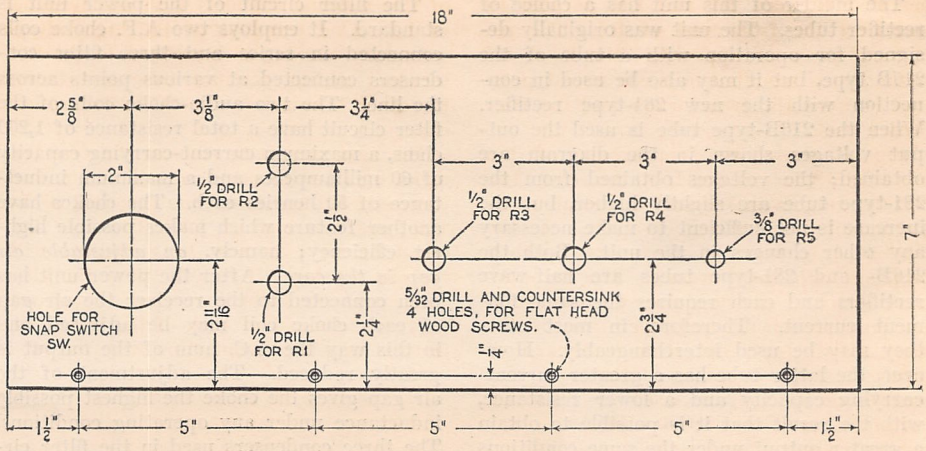


Fig. 3. This diagram shows the exact positions and dimensions of all holes required in the front panel for mounting the various parts shown in the pictures.

SPECIAL FEATURES

In the first paragraph of this article it has been stated that this power pack was designed especially for the "Neutroheterodyne" receiver, but that it may be used successfully with other receivers employing approximately the same number of tubes. Before describing the construction of the unit, it will be explained which features apply especially to the Neutroheterodyne; as these need not be incorporated in the power pack if it is to be used with another receiver.

In the first place, it will be noticed that the diagram calls for wires of eight different colors in the output circuit. These colors are the same as those used for corresponding wires in the "Neutroheterodyne" receiver; but the color code should be adapted to the receiver with which it is to be used. Secondly, the audio choke in the plate-supply wire to the first detector is not needed with the average receiver; but it is essential for the operation of the "Neutroheterodyne." Thirdly, in a large number of cases, it will be unnecessary to mount the loud-speaker choke coil in the power unit; as in many receivers this piece of apparatus is mounted on the baseboard of the set. Also, in some sets, an output transformer is used in place of the loud-speaker or output filter.

The illustrations on these pages clearly show the construction of the power pack. The picture reproduced as Fig. A indicates the arrangement of controls on the front panel, and from this view of the unit it may be seen that there are six adjustment knobs. The switch for turning the power on and off, and for regulating the input to the unit, is located at the extreme left of the panel at SW. This is a standard snap switch with one "off" position and three "on" positions. It is mounted on the case of the power transformer, and it will be necessary to cut a large hole in the control panel to make possible the adjustment of the knob from the front.

The knobs R1 and R2 are arranged, one above the other, slightly to the right of the switch. These knobs control the adjustment of rheostats which regulate the filament current delivered to the 7½-volt tubes; R1 is for the rectifier circuit and R2 is for the power-amplifier tube.

Between the rheostat knobs and the right edge of the panel, three knobs are mounted, at even distances, on a line slightly below the center of the panel. The knob at the left (R3) is for regulating the grid potential applied to the power tube; the knob in the center (R4) is for regulating the bias applied to the amplifier tubes of the set, and the knob at the right (R5) is for adjusting the detector voltage.

ASSEMBLY

The arrangement of parts mounted on the baseboard of the power unit is shown in Fig. B. When looking at the unit from the rear, the power transformer (T1) will be seen located in the front right corner of the baseboard in such a position that the key of the snap switch protrudes through the hole drilled in the front panel. At the rear edge of the baseboard, directly behind the power transformer, the tube socket (V1) for the rectifier has been mounted. This is the ideal position for this unit, as it keeps the high-voltage leads from the power transformer as short and direct as possible.

The two filter-choke coils (L1 and L2) and the loud-speaker choke coil (L4) are of identical construction, and these are mounted about one inch apart, at the rear edge of the baseboard, starting slightly to the left of the rectifier tube socket. L4 is on the left, L2 is in the center and L1 is on the right; as this arrangement makes the simplest possible wiring. The three condensers of the filter circuit are also identical. These are arranged so that their terminals face the right of the baseboard, and are mounted, one behind the other, directly in front of choke coils L2 and L4. The wiring is simplest when the condenser near the rear of the baseboard is made C1, the condenser in the middle C2 and the condenser nearest the panel C3.

Battery clips are used in place of binding posts and these are fastened directly to the wooden baseboard with wood screws. Nine clips are required and they are mounted approximately one inch apart on the left edge of the baseboard. The choke coil for the first-detector supply wire is mounted near the front edge of the baseboard, between the condenser C3 and the battery clips. The resistor (R7) of the resistance bank is a long thin unit and it is mounted on the base so that it runs from rear to front. Its position is between the battery clips and the choke coil (L4), starting at the rear edge. The resistor R6 is a comparatively short unit and is

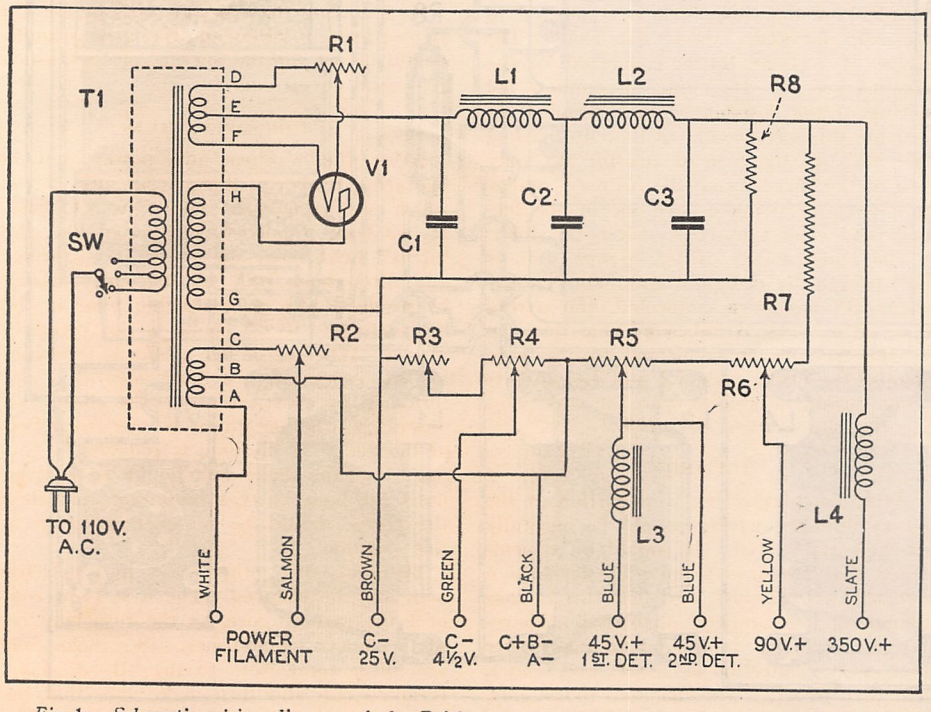


Fig 1. Schematic wiring diagram of the Reich power pack. It will be noticed that a color-code wiring system is called for; that employed here corresponds to that used in the wiring of the "Neutroheterodyne" receiver, for which this power unit was especially designed.

mounted between R7 and C1, parallel to and near the front end of R7. The remaining piece of apparatus, the fixed resistor R8, is mounted in a convenient position between the transformer and the condenser bank.

Fig. C shows the appearance of the power unit when viewed from the rear. The rectifier tube is in the socket and all parts are mounted and wired correctly. As the baseboard is wood all parts are fastened in place with wood screws. The arrangement which is shown makes for the shortest possible wiring and, therefore, is the most satisfactory, but if a baseboard of different shape is employed the location of the various pieces of apparatus may be shifted without materially affecting the results.

However, if the arrangement is changed it is important to separate each of the choke coils by at least one inch from all surrounding apparatus. The position of the choke coil in the plate-supply wire of the first detector is also important, and this should be placed as far as possible from the power transformer and filter choke coils. Also, this instrument should not be screwed permanently to the baseboard until after the power unit has been placed in operation; as it should be turned until it is in such a position that it causes no hum.

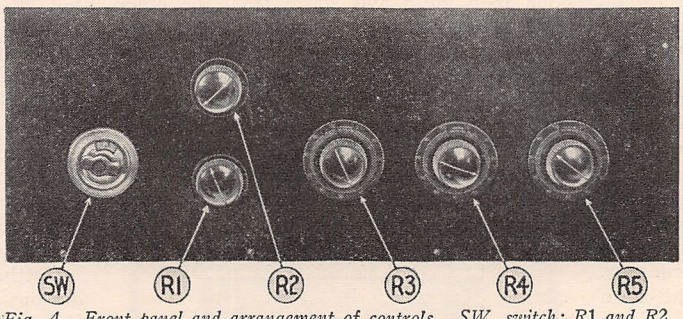


Fig. A. Front panel and arrangement of controls. SW, switch; R1 and R2, rheostats; R3 and R4, biasing resistors; R5, detector-voltage (plate) resistor.

WIRING

After the assembly of apparatus on the baseboard and front panel of the power unit has been completed the wiring may be started. Fig. 1 shows the circuit in schematic form, and in Fig. 2 the complete wiring is given in pictorial form. It will be noticed that the system used in wiring the set is very simple and that all wires are located above the baseboard. For this purpose well-insulated flexible wire must be used.

From the circuit diagram it will be seen that the primary winding of the power transformer is the only part of the circuit which is connected to the 110-volt, 60-cycle house-supply wires. There is in the primary circuit of this transformer a three-point snap switch which makes it possible to turn off the unit, or to change the number of turns used in the winding, for the purpose of regulating the power. In the transformer selected for this power unit this switch is built into the transformer and requires no additional connections; but, if another transformer is substituted when building the set, it may be necessary to connect a switch of this type externally to the transformer. In the case of the transformer under discussion, the three points of the snap-switch adjust the power unit for operation in 60-cycle circuits of 110, 118 and 125 volts, respectively.

There are three secondary windings on the power transformer; two center-tapped filament windings and one 525-volt plate winding with a capacity of 60 milliamperes. One of the filament-heating secondary windings is connected to the filament of the power tube, with the rheostat R2 in series with one of the connecting wires. The center tap of this winding is connected to the "B—" binding post of the power unit. The second filament winding is connected to the filament of the rectifier tube with the rheostat R1 in series, and the center tap of this winding connects with one terminal of L1. One terminal of the high-voltage secondary winding is connected to the "P" terminal of the rectifier tube socket and the other terminal to the "C—25" terminal clip.

The next step is to connect the free terminal of L1 with one terminal of L2, and, then, connect the remaining terminal of L2 with one terminal of L4. The free terminal of L4 may now be connected with the clip marked "B+350". Next the filter condensers should be connected. First connect one terminal of each of the three condensers to a wire connecting with the "C—25" clip, and then connect the free terminal of C1 with that terminal of L1 which connects with the center tap of the filament winding; connect the free terminal of C2 with the wire joining choke coils L1 and L2, and connect the free terminal of C3 with the wire joining choke coils L2 and L4.

The voltage-dividing resistor bank may now be wired. The first step is to connect the resistors R3, R4, R5, R6 and R7 in series, in the order mentioned. The free terminal of R7 is then connected with the wire joining the choke coils L2 and L4. The center-tap of resistor R6 is next connected with the clip marked "B+90." Two wires are then connected to the slider terminal of resistor R5 and one of these wires is connected to the clip marked "B+45—2nd Det." and the other is connected to one terminal of the choke coil L3. The other terminal of the choke coil is connected to the clip marked "B+45 1st Det." The slider of resistor R4 is connected to the clip marked "C—4½" and, to complete the wiring of the resistor bank, a terminal of resistor R3 is connected to the clip marked "C—25." In the case of resistor R3, only two of the three terminals are used, and it is important to make sure one of the terminals to which contact is made is the slider.

The construction of the power unit is now practically complete and, after the resistor R8 has been connected, the wiring may be considered finished. One terminal of this resistor is connected to the wire joining the choke coils L2 and L4, and its other terminal connects with the wire joining the clip marked "C—25."

TESTING

After completing the construction of the power unit the wiring should be carefully checked and tested. It should be remembered that the transformer T1 develops a potential of 525 volts, and that this is dangerous if not properly insulated. Therefore, it is highly important to make sure that every connection is correct and secure, and that all wires are insulated thoroughly.

In order to test the power unit it is necessary to connect it correctly with the receiver, and *all tubes* of both the receiver and power unit *must be in their sockets* when the power is turned on for the first time. This is important; for, if the power were connected and the tubes were not in their sockets, the high voltages developed would be apt to burn out the filter condensers.

As soon as possible, after the power has been turned on, the various knobs should be adjusted to their correct positions. It is particularly important that the resistor R3 be adjusted; for, if the power tube receives insufficient bias, it is apt to overheat. Before turning on the power it is a wise idea to introduce into the circuit as much resistance as possible with resistors R1, R2 and R3, and then, after the power has been applied, slowly reduce the resistance until proper operating conditions are established. If this system is followed the apparatus is protected from damage which might be caused by the high voltage.

In adjusting the various controls, meters should be used if they are available. An A.C. voltmeter with a range of 0 to 10 volts may be used for checking the filament potentials applied to the rectifier and power tubes, and a high-resistance (1,000 ohms per volt) D.C. voltmeter with a range of 0 to 150 volts may be used for adjusting the "C—25," "C—4½," "B+45" and "B+90." The final adjustment of the "C—25" voltage is not made until after the receiver is operating properly, and then an 0 to 50 D.C. milliammeter is used for the purpose. This meter is connected in series with the 350-volt supply wire and a loud signal is tuned in on the receiver. When the volume of music from the loud speaker is at maximum, the knob R3 should be adjusted until the needle of the milliammeter is practically stationary. Of course, the knobs may be adjusted quite satisfactorily without the use of meters; and, if the experimenter is careful, the results will be practically as satisfactory.

In operating the receiver without the aid of measuring instruments, the various knobs should be set for the lowest voltages which give good performance.

PROBLEMS OF HUM

After the receiver and power unit is operating properly, there is an adjustment which may be made to reduce the A.C. hum. It has been previously mentioned that the "stray" field from the power transformer and filter-choke coils is sufficiently strong to produce a very noticeable hum if the first-detector "B+" choke is not properly placed. Whether or not a hum is produced by this cause may be most accurately determined by short-circuiting the choke and observing whether there is any reduction of the hum. If the hum is reduced by this operation, the choke coil should be revolved until the hum is at a minimum, and then the choke should be fastened securely in this position.

There are two other ways in which the hum may be reduced. The first is to connect the case or core, as the case may be, of the power transformer, filter choke coils and filter condensers to the "B—A—C+" terminal clip and then make sure that the "B—" wire of the set is grounded. The

(*Continued on page* 64)

Improving Reception on A Thin Pocketbook

Some Practical Data on Bringing the Atwater Kent Model 20 Receiver Up to Date, at Little Expense and Effort

By Luther C. Dilatush

IT'S certainly a big thrill to play around with a superplexodyne, screen-grid tubes, or what have you; but while the experimenter is doing this, I think there is another fellow that deserves a little attention. He is the man with a three-dial, five-tube set and horn speaker. If you think he no longer exists, just look around.

About three years ago, literally millions of these typical five-tube sets, such as that shown in Fig. A, were sold. As few of them wear out, someone is using them now. Most of these still have the old horn speaker; as they were designed to operate a horn and do not give results entirely satisfactory with any other type of speaker. It is to the owner of this type of set that this article is dedicated.

No doubt this fellow is still using this comparatively old-fashioned type of set because he can't afford a new one (I'm in that class) and because he doesn't know any inexpensive way of improving it. If you have one of the sets described, would like to improve your reception greatly—and have from fifteen to twenty dollars—read on! The purpose of this article is not to advance a single new theory, but to increase the radio enjoyment of the masses.

AMPLIFICATION LIMITED

First, what have we in the typical five-tube, tuned-radio frequency-set, such as the writer's Model 20 Atwater Kent, shown in Fig. A? The radio frequency is fairly satisfactory to the average home listener, who would rather hear music from a nearby station than mush and static from the other side of the continent. The audio is a two-stage transformer-coupled affair. Distortion in one of these receivers is not unbearable and the musical range will not be quite so limited as some of the manufacturers of new transformers picture it.

Notwithstanding this, the set lacks the ability to produce full, round tones, and the

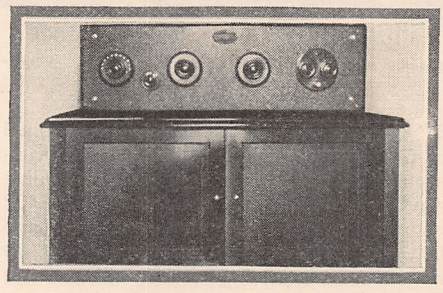


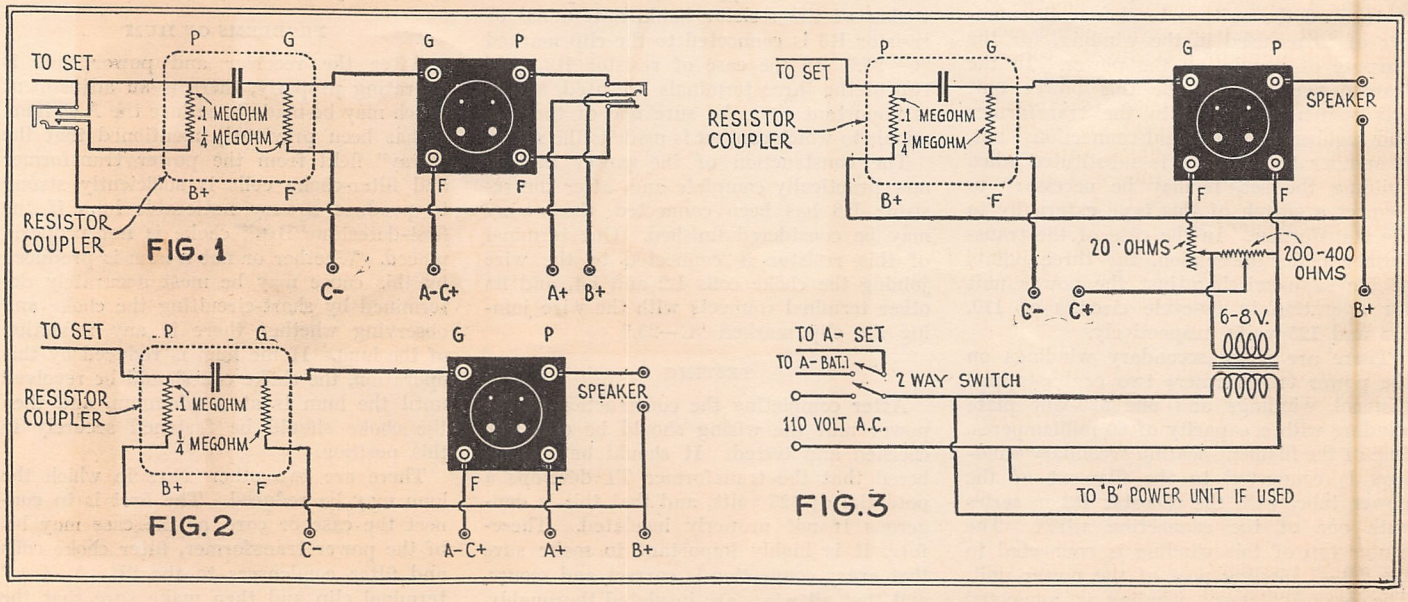
Fig. A: This type of receiver is one of the most widely-used in the United States, although it is no longer being manufactured.

volume is inadequate for real enjoyment with a cone. A cone? Yes. I believe the cone that I am using is as good a reproducer as can be had, figuring on a basis of quality per dollar. The horn on this ordinary set is the big robber of quality; but the mere addition of a cone is not enough, for the reasons stated. We want full, round tones and volume.

Ah, a power tube? I tried putting one in the last socket of my set, but quality was not all I had hoped it to be, and volume was less. Let this sink in for the last time; a 171 gives less amplification than a 201A, but is capable of handling more volume. This point has certainly been made plain enough, but I still hear people say that their volume is poor and they want a power tube to give them power and more volume. If your lack of volume is due to the last tube's overloading, fine. A power tube will fix you up. Otherwise, no.

Getting back to the subject, it is now obvious that more amplification is desirable. Conclusion—another stage of audio. After trying resistance-, transformer-, and impedance-coupling, I have hooked up a resisto-coupler to my last tube. It really has high amplification power in the last stage, and it affords real quality in its tones (if the signal going to it is pure). In the third place, it is cheap, and we are considering cost.

The reader may now ask about the transformers in the set. Do they not so limit the musical range that decent reproduction cannot be obtained? In the type of receiver pictured, *practically* they do not. After trying new transformers in the set, putting resistances across secondaries, etc., I decided to let the audio end of the set alone. There are two more strong reasons for this; undoubtedly new transformers improve the tone somewhat, but we are figuring on a value-per-dollar basis, and that lets expensive, heavy-core transformers out. Second, the average broadcast listener has no desire to take a factory-made receiver apart and rebuild it.



Three different methods of adding the additional stage of resistance-capacity-coupled amplification to the old receiver. In Figs. 1 and 2 the extra tube works off the storage "A" battery; in Fig. 3 on A.C. supplied through a step-down transformer.

FEW PARTS NEEDED

Considering all these facts and limitations, the final result was an added stage of resistance-coupled audio and a home-made cone speaker. As we are considering low cost as a primary essential, let's sum up the cost now. These figures are slightly above what the large city stores charge for

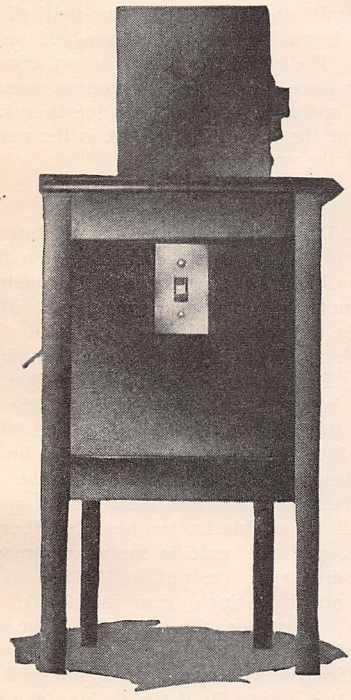


Fig. C: How the two-way switch shown in Fig. 3 is mounted on the side of the cabinet holding the radio receiver.

these parts; and, no doubt, you have some of them lying around somewhere.

171-type power tube	$3.50
Socket	.40
Coupling condenser and two resistors	2.50
Cone unit (about)	7.00
Cone paper	.75
Cone apex	.25
Total	$14.40

You will probably have to buy a 25-cent can of cone-paper cement and some ribbon and braid to decorate the cone, if you care for appearances. A.C. equipment, consisting of a bell-ringing transformer, potentiometer, and rheostat, is optional. Remember, this cost of about fifteen dollars includes the power tube and speaker. Compare this with the cost of an advertised speaker alone!

Now let's stop raving for awhile and get down to actual work. The best place to start is with the amplifier. The first question might well be, where to put it; Fig. B shows where I put mine. This arrangement is recommended as convenient and out of the way when the set is placed on a battery table or cabinet. However, a small board or box arrangement behind the set will not be unsightly, and will certainly work as well. The twisted wires going down from the power tube are the A.C. leads, while the "B" and "C" connections are cabled. The filament is lighted by alternating current. The potentiometer may be seen at the right of the "C" battery, and the bell-ringing transformer is on the other side of the storage battery. A.C. operation is advised from the standpoint of economy. This tube draws very little current from your house circuit; but it would be necessary to charge the battery somewhat oftener if the power tube operated from that source of current. Unless you wish to be able to change quickly from five to six tubes, omit jacks; I have them on my set but never use them. If you run this extra tube from your storage battery, no extra rheostat will be needed.

LISTS OF PARTS

Here's the shopping list for the amplifier: one 171-type power tube and socket for the same; one .01-mf. fixed condenser and two grid-leak mountings; two resistors, one 1/10-, one 1/4-megohm.

A double-circuit jack and an open-circuit filament-control jack are optional, as observed above.

For A.C. operation, add one 6- or 8-volt bell-ringing transformer, one 200- or 400-ohm potentiometer, and one 20-ohm rheostat.

The hook-ups with and without jacks are Figs. 1 and 2, respectively; while Fig. 3 gives the connections when A.C. instead of storage-battery operation is adopted.

You will notice a two-way switch in the circuit of Fig. 3; this is very convenient, and is much cheaper than any relay arrangement. Fig. C illustrates a switch of this type installed in the end of the radio table. Of course this may be replaced by a knife- or snap-switch in back of the set. The use of this eliminates the use of the set switch; just leave the latter on all the time. The wire marked "to set" goes to the outside speaker post, next to the end of the cabinet.

BATTERY OPERATION

If you want to run this tube on your storage battery, first take all the wires off the binding posts in the back, remove the eight screws that hold the panel, and slide the panel out. Take a piece of flexible wire, of ample length to reach to your new tube, and tin one end for soldering. Now lay the panel on a table, dials down, and stand facing the wiring under the sockets. At the extreme lower left-hand corner you will see a hole in the sub-panel, with a wire coming through it and connecting directly to the nearest contact of the nearest socket. This is right below the speaker posts. Solder the flexible wire to this contact spring, where the wire coming through the sub-panel is soldered. This is your "A—" wire to the power tube. It will now be necessary to advance the right-hand rheostat a little further to bring the tubes up to proper brilliancy, as another tube is now connected to this rheostat.

Now, a word about "B" and "C" current. If you are using "B" batteries, put three heavy-duty 45-volt batteries, or 135 volts on all amplifier tubes. Give the detector tube all it will take without howling. For the sake of reducing the drain on the "Bs," use about 30 volts of "C" current on the power tube. This voltage can be built up with ten-cent three-volt flashlight batteries. This will cost a dollar for thirty volts and, by experience, these batteries last well over a year, as there is no current drain on them. The only requirement is to keep them reasonably dry.

If you have a "B" power unit, however, and the current drain need not be so seriously considered, I don't see where this high "C" voltage is an improvement. In theory you should have it, but 15 volts works as well as 30 in mine. In a set that I recently improved according to these instructions, only 9 volts is used and the set works like a charm. Use your own judgment. Of course, put the full voltage of the unit, up to 200, on the power tube.

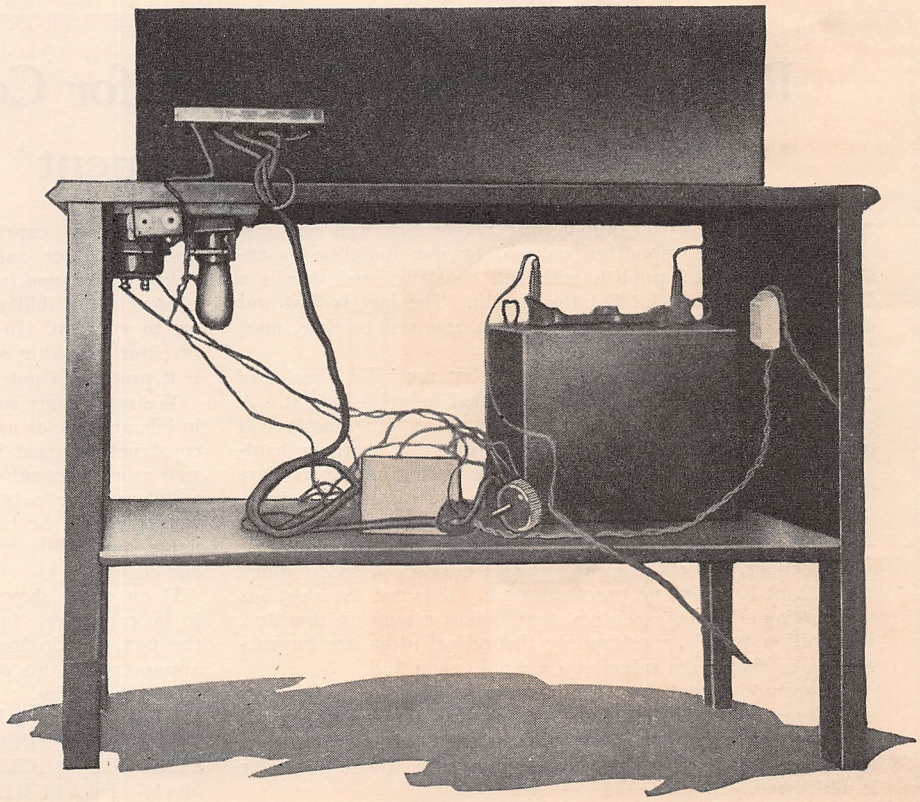


Fig. B: The tube and the other parts comprising the extra stage of amplification are fastened in the upper left corner of the battery compartment. The white object on the right wall of the cabinet is the two-way switch.

CONSTRUCTING THE CONE

Next in line is the cone. Get a sheet of cone diaphragm paper, a small can of cement for the same, and an apex. Don't economize on a $2.95 unit; get a good cone unit with a rather heavy magnet.

First, let's do the cone properly. Take the familiar pin, string, and pencil arrangement and mark out a 30-inch circle; carefully cut this out, and cut out a sector 6 inches wide. When finished, the cone will be approximately 28 inches in diameter. This was found a happy medium between the very large and smaller cones. It does not have the familiar nasal twang of some of the smaller cones, and it is much easier to handle—and to find a suitable location for—than the larger cones.

Now bring the cone around into shape, with a half-inch lap for glueing. Do not make the lap any larger than this, or it will curl and spoil the regular surface of the cone. No doubt you are now having trouble with the apex of the cone. Take out tiny V-shaped pieces until the paper does not wrinkle and cut a small hole at the exact apex for the adapter to fit through. You are now ready to cement the joint on the cone. Give the two sides of the joint a light coat of the cement and let it dry. Now give it another light coat and press the two sides firmly together. Do not use too much cement or it will run out on the front surface of the cone. An electric iron, slightly warm, can be used advantageously for ironing out this joint. Do not use too much heat, or it will curl the joint and scorch the paper. Now cut a six-inch circle out of the remainder of the cone paper, and fit it smoothly inside the cone at the apex. There does not have to be any lap in this. Give the entire underside of this reinforcement a good coat of cement and be sure that, when it dries, there are no loose edges to rattle. (This advice applies also to the cone proper.) If you want a smooth, strong job, do not omit this reinforcement. The apex adapter should now be attached.

Next is the decoration. Fig. E shows how mine is done. This is just a suggestion. The four strips that panel the cone into four equal parts are half-inch brown ribbon glued to the surface. The main reason for these strips is the fact that one of them covers the joint in the paper. The braid at the edge is sewed on; this makes a more workmanlike job than trying to glue the braid to the edge. One-half of the braid is on the front and one-half on the back. The stitches do not show, even on rather close inspection. Of course, decorating is optional, and may be done to suit the taste of the individual. Next is the mounting of the unit.

MOUNTING THE CONE

Fig. D shows how the unit is mounted on the wall. First, lay the cone on the floor, and push a piece of wire down through the apex until it just touches the floor. Measure the length of this wire and add about ¼-inch for the stylus to extend through the cone. For example, let's assume that the result is 8¼ inches. Now subtract the distance from the base of the cone unit to the end of the stylus. Say this is 3½ inches; that leave 4¾ inches, by which the unit must be separated from the wall. A spacer is built up of blocks bradded together, as shown, and the unit is mounted upon it. Two screw-eyes are put in the top of the block about an inch from the front; now attach the cord as illustrated. Make each side of this about nine or ten inches. Be sure that the nail holding the unit will not touch the cone! Hold the unit on the wall so that the stylus comes where you want the cone to center. Now draw up the cord and drive a small nail into the wall to hold the unit in place. Be sure that the block

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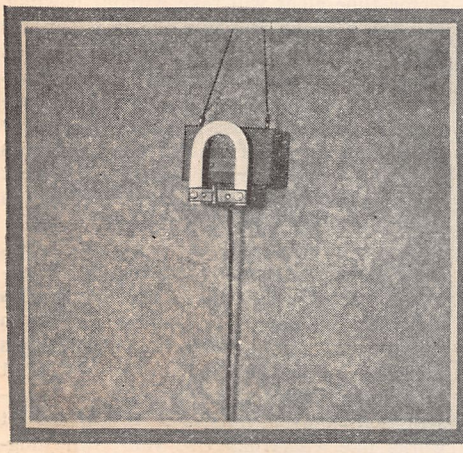


Fig. D: How the cone's driving unit hangs on the wall.

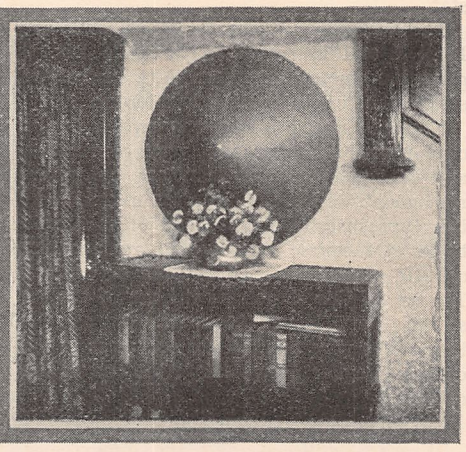


Fig. E: The completed cone hanging in place over a bookcase.

Radio News Monthly Prize for Constructors---An Announcement

WE regret to disappoint our readers, as well as those who have submitted entries, by our inability to announce and publish with full constructional details a Prize-winning Blueprint Set this month. The fact is that, out of the several entries which have been received to date, none fills the bill satisfactorily.

To win the hundred dollars, an entry must be *novel and practical* enough so that we are justified in publishing it. A skillful and workmanlike construction of an old circuit will not do; neither will a new idea which depends upon mechanical construction so difficult that the majority of our readers cannot undertake it. The accomplishments of such constructors are creditable, but not suitable for the purpose announced—the promotion of new constructional work by our readers.

We cannot undertake to accept and develop ideas on which the entrant has done no practical work. It is not the idea, *but the putting of it in execution,* that makes a man an inventor. In addition to this, most purely theoretical ideas are impracticable, as those who submit them would soon find.

We cannot accept for this purpose a new device, however well done, which is designed by a manufacturer or an engineer working for or with him; this would be unfair to the home and shop constructors and experimenters, to whom this offer is addressed.

RADIO NEWS, however, stands ready and willing to pay $100 to each such experimenter who presents a receiver, power pack, or other radio apparatus *which embodies* something *actually new, and is suitable for a Blueprint Article* which will present a possibility for any considerable number of our readers to work on. In addition, it will defray the expenses of the inventor in taking out a patent in his own name, on his device, if it presents a patentable feature.

We repeat our conditions: a clear, clean schematic diagram in ink, and one or more good sharp photographs, proving actual construction, must be sent with each entry in this contest, as well as a statement of what has been accomplished. The manuscript must be in typewriting or written in ink in legible handwriting; each sheet and illustration must bear the constructor's name and address, and all must be fastened together and *mailed flat.*

If an entry shows sufficient novelty, merit and practicality to be considered further, the constructor will be informed of the fact, and instructed whether or not he should ship in his apparatus to this office, and what further information is required from him.

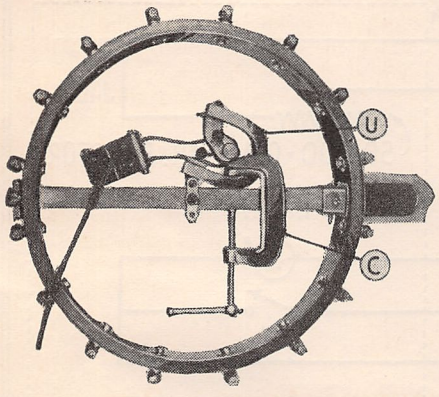
RADIO NEWS RESERVES THE RIGHT TO SUBSTITUTE AND SPECIFY OTHER APPARATUS IN THE PUBLISHED ARTICLE; ALWAYS PRESERVING THE MAIN FEATURES, HOWEVER, OF THE ORIGINAL DESIGN.

A Banjo Speaker

FEW novelties will afford more amusement in the radio field than the banjo speaker. It can be made in a few moments; or, if a permanent arrangement is desired, this may be made also by the expenditure of a little more time.

The requisites are: a banjo, tenor-banjo, banjo-mandolin or other instrument of the banjo family. (Banjo-ukes are too small to give really satisfactory results.) If the instrument is fitted with a resonator, so much the better; as this conceals the unit. A small cone-type loud-speaker unit is also necessary, with a cord connector, a connecting cord and a standard radio plug.

The unit (U) is placed inside the banjo, as shown in the first illustration, and clamped there with a small C-clamp (C).



A banjo is converted into a loud speaker by clamping the speaker unit (U) in place with a "C" clamp (C) as shown above.

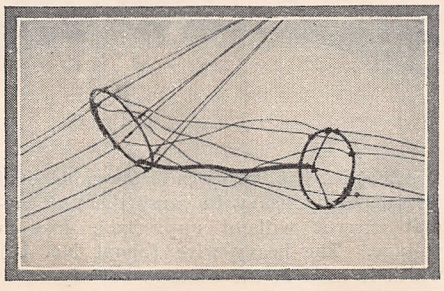
This arrangement will not injure the instrument in the least; but, as the contact with the head is made by pressure alone, the speaker may blast at times. If a permanent installation is preferred, the unit is clamped directly to the bar with the usual clamp used in mounting units. A hole is pierced in the head of the instrument, at the center, and the usual apex, cut down to ½-inch diameter, or less, is attached.

In use, the cord is connected to the unit and plugged into the receiver in the usual manner. It can be used, of course, for the reception of any broadcast; but, if a banjo solo can be tuned in on the phones and the speaker then connected by means of an extension cord in some other room, a great deal more amusement can be secured.—*H. C. McKay.*

A "Cage" Connection

MANY dyed-in-the-wool radio fans prefer to use cage aerials instead of the usual single-strand type. The cage possesses certain electrical advantages, but it is much more complicated in mechanical construction.

In building a cage aerial, one of the most



A cage-type lead-in may be strengthened mechanically with a bridle of heavy wire, as illustrated here.

difficult problems is attaching the lead-in wire; and this is true particularly if the lead-in is also of the cage type. The lead-in of the writer's aerial was of the cage type them. However, this method proved unsatisfactory; as frequently, during heavy gales, one or more of these attachments would break off.

After considerable experimenting an excellent method was found for connecting a cage lead-in with a cage aerial and this is illustrated in the accompanying picture. A bridle of heavy wire is inserted in place between the rings of the aerial and lead-in, and this is securely soldered to each ring. The bridle is slightly shorter than the normal distance between the rings, thus allowing a slight slack in the lead-in strands. With this method, the entire strain is taken up by the bridle, and there is no tendency for the lead-in strands to break.—*L. B. Robbins.*

IN compliance with a popular demand, "Radio Wrinkles" will again appear as a featured department of Radio News, *beginning with this issue. In the March issue the final prize award for "Radio Wrinkles" was published, and the department was discontinued. However, during the past few months so many letters have been received requesting more "Wrinkles" that it has been decided to re-establish the department. A year's subscription to* Radio News *will be given in compensation for each accepted item. If the author of the wrinkle is already a subscriber, his subscription will be extended one year or he may accept a one year's subscription to* Science and Invention *or* Amazing Stories, *both published by the Experimenter Publishing Co.*

An Automatic Control

A DEVICE which may be made to compensate automatically for the change in efficiency of a radio receiver on different wavelengths is illustrated in the picture on this page. It is a standard variable condenser, to which has been added a variable resistor. The unit is so designed that

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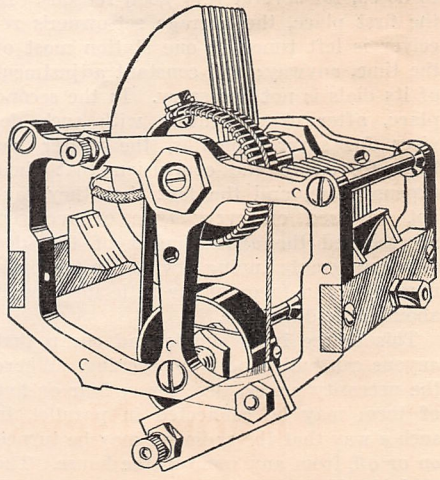
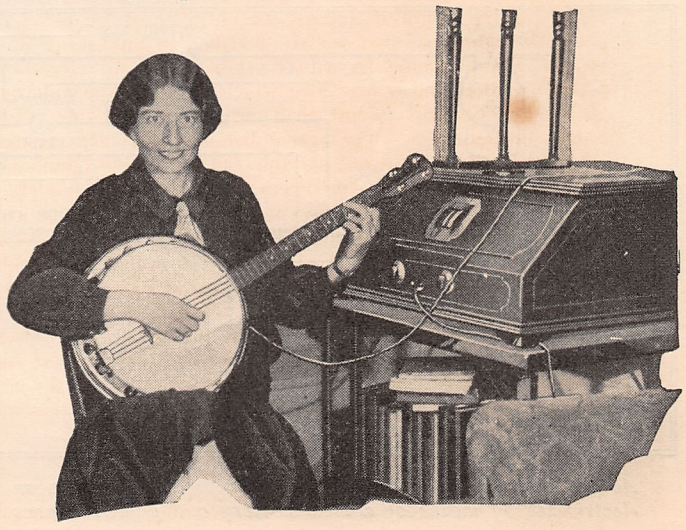


A rheostat resistance unit, mounted on the shaft of a tuning condenser as shown, makes possible many circuit improvements.



Considerable amusement may be secured by having someone hold this speaker while it is reproducing a banjo solo. Of course, the guests should not be let into the secret till afterwards. See first article on this page.

A Simple Remote Control Device

by William F. Crosby

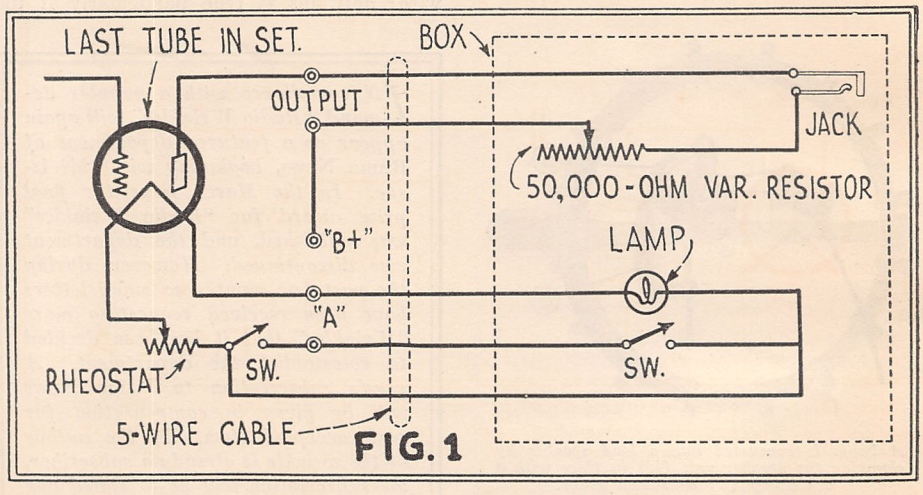
THE prime requisite of a radio remote-control device is that it be compact. It should be also cheap and easy to make and capable of being adapted to almost any form of circuit. In working along these lines, the writer has reached what he believes to be a practical solution of the problem.

The instrument described in this article *will not tune the set* and was not designed to do so, for several very good reasons. In the first place, the average set-owner's receiver is left tuned to one station most of the time, anyway; and constant adjustment of its dials is not necessary. In the second place, after experimenting with such devices for several months, the writer has been forced to the conclusion that their expense, size, and the fact that they cannot be used on every type of receiver, necessitated the abandonment of the idea of using remote tuning devices, in the ordinary home, in favor of the little instrument about to be described.

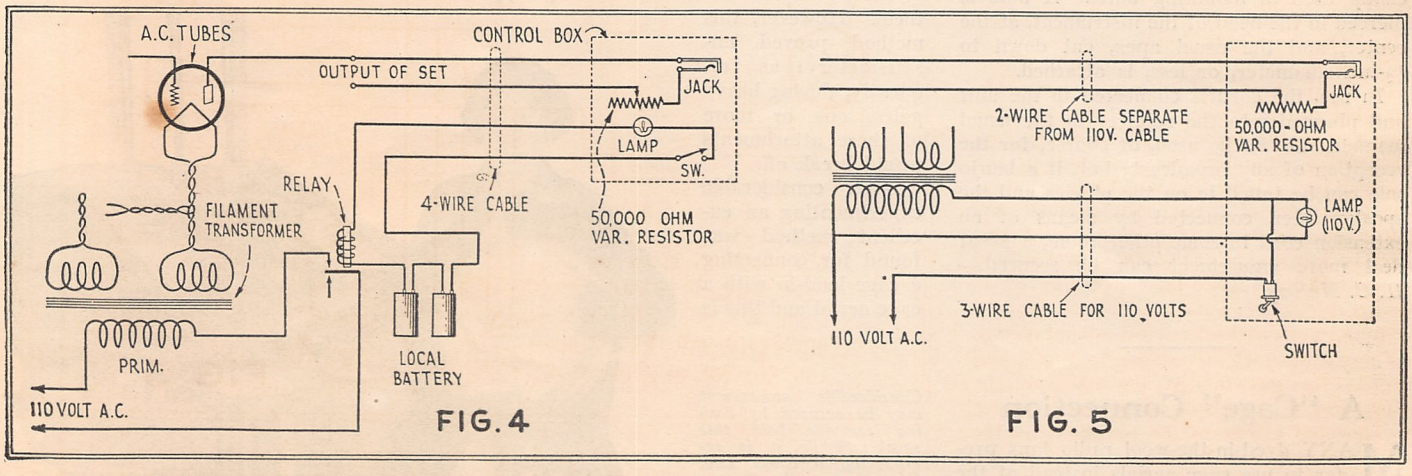
This device is so simple and cheap that anyone can build one in an evening. Where the necessity arises, two, three, four or five of them may be connected in parallel, in such a way that the radio set may be turned on or off from any room in the house. The variable high resistor employed makes it possible to control the volume from a whisper to the full power of the set. One or all of these controls may be used at the same time, to control different speakers in different parts of the house.

There is just one essential requirement, and that is, that the wires in the cable shall be sufficiently heavy to carry the "A" circuit current without appreciable loss in voltage. The heavy wire (about No. 18) which is used in the average battery cable has been found satisfactory so long as the distance does not exceed twenty-five or thirty feet. For distances in excess of this, the size of the wire should be increased somewhat, because the resistance of the regular wire may be too great. Where several of these remote controls are used, it is advisable to wire the house with heavier cable (No. 14 or No. 12), taking off the leads to the various remote controls as they are wanted in the different rooms.

It is highly essential to use wire which has insulation of different colors, in order that the connections may be readily identified; but, where this cannot be done, a "tracer" circuit, consisting of a low-voltage battery and a pair of head receivers, should be used to determine the ends of the various wires. If the ends of the wires are grounded, one at a time, while the other ends are tested with the receiver and battery connected to



Schematic arrangement of the simple remote-control unit described here.



At the left, the remote-control unit is used to operate an electric set by means of a local battery and high-resistance relay. With the direct A.C. connection at the right, a power switch and a 110-volt pilot lamp must be used.

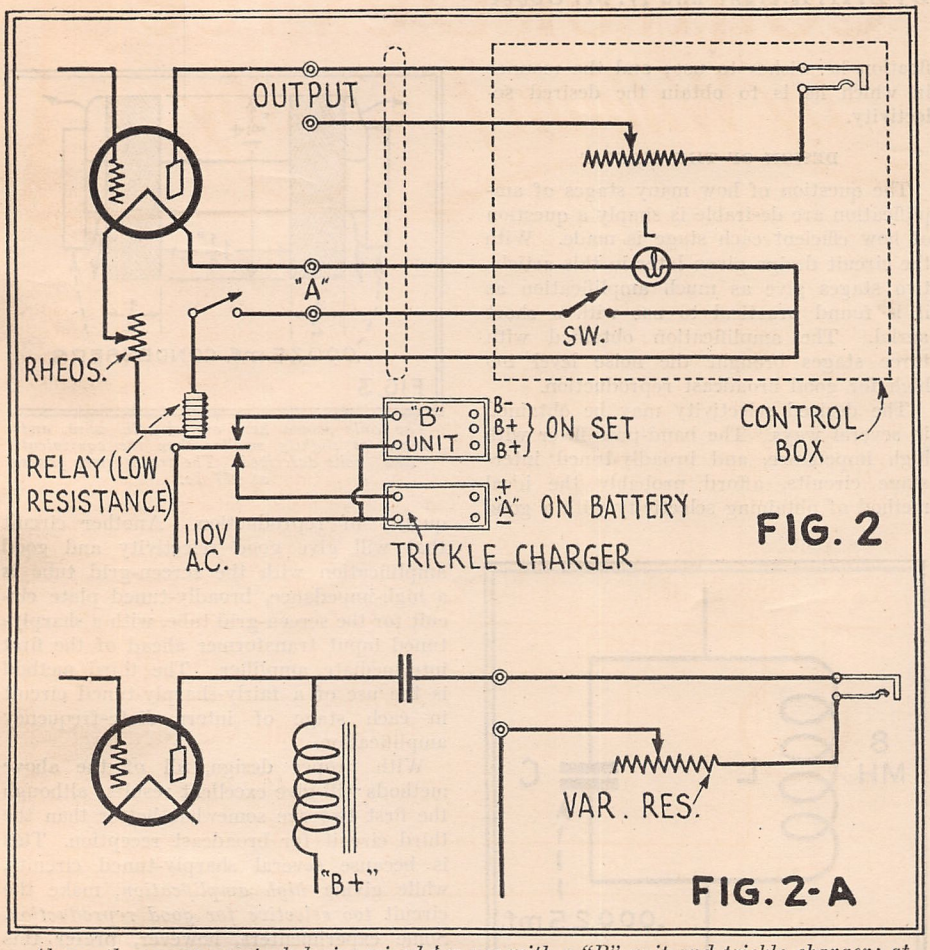
an adjacent ground, it will be a simple matter to tell the wires apart. Each should be tagged, if the insulation is all of one color.

DESIGN OF THE UNIT

The remote-control unit itself is only about six inches long and two inches wide, and set into a box about two inches deep. The panel may be bakelite, hard rubber or a suitable piece of wood, secured in a wooden or metal box in such a way that the entire assembly will look like a miniature radio set. It is suggested, though, that the panel be placed on top instead of the side, as this will make it somewhat easier to operate.

Exactly in the center of the panel we place a variable high resistor, in the neighborhood of 50,000 ohms as its maximum value. On one side of this we place a pair of tip jacks, or, as in the case of the unit shown in the illustrations, a combination jack. On the other side and spaced at equal distances from the center, we have an ordinary battery switch, of either the push-pull or the toggle type. Above this will come a miniature-lamp socket, fitted with a small six-volt bulb. Through the panel over this bulb is inserted a ruby lens, which will show a red light when the battery switch is turned on; this is optional, but its use will be found both attractive and advantageous.

The wiring is clearly shown in Fig. 1 and also in the drawing of the back of the panel, Fig. 6. One side of the lamp socket is connected to one of the terminals on the battery switch, and from here a wire in the cable is taken to the set. The other post on the battery switch will go to one side of the "A" battery circuit, the polarity having no effect in this case; while the remaining terminal on the socket will be connected to the opposite battery terminal. These two battery connections may be made either at the set, direct to the battery or through a cable which may be run throughout the entire house. The variable resistor is simply connected to one of the output binding posts or the output jack on the set; while the other terminal of the resistor is wired to one of the phone tip jacks. The other jack terminal will be wired directly back, through the cable, to the remaining output terminal on the set.



Above, the remote-control device wired for use with a "B" unit and trickle charger; at the bottom, the connections when an output filter is added. The "A" battery is connected across the terminals marked "A."

VARIOUS CONNECTIONS

This is shown in Fig. 1, which, in addition, shows the actual terminals as they are connected to the set. Note that one wire (the lowest one) runs inside the set to a point above the battery switch. If no battery switch is used, this connection will be made above the first rheostat. With this connection, the switches on both the set and the remote control are interlocking in such a way that, when either switch is turned on, the red light in the remote control will be turned on.

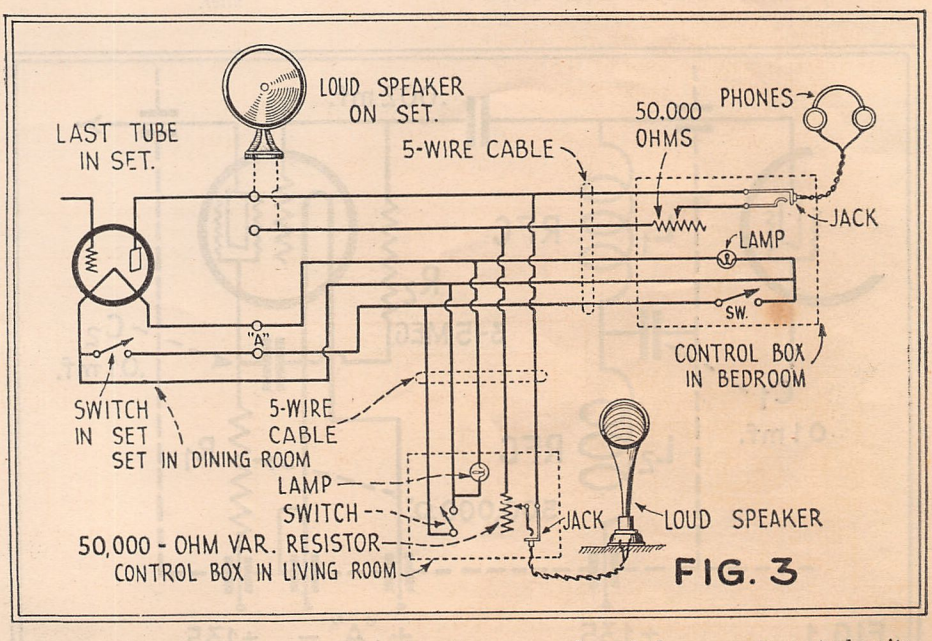
In Fig. 2, we have the same arrangement, but in this case it is necessary to turn on a "B" socket-power unit when the set is turned on, and a trickle charger for the storage "A" battery when the set is turned off. A low-resistance, double-acting relay does the trick here and it should be connected exactly as shown in the drawing. These devices may be purchased at almost any radio store. You will note that the relay is so connected that, when the "A" battery circuit is closed, the armature will come down and make contact, closing the 110-volt circuit and thus putting the "B" supply unit in action. When the "A" battery circuit is opened, the armature on the relay springs upward and closes the 110-volt circuit to bring the trickle charger into use. It is highly essential that *this relay be of low resistance;* otherwise it will take so much current to pull it down that the "A" battery will not be able to supply enough for the tube filaments. (An old telegraph sounder will NOT do the work.)

Fig. 3 is simply a repetition of Fig. 1 except that it shows how two remote controls may be used at the same time. Additional instruments may be added by simply connecting them in parallel.

FOR ELECTRIC SETS

Fig. 4 indicates the remote control as connected to a set using full A.C. operation.

(*Continued on page* 64)



It is possible to operate several speakers from a number of these remote-control units when wired as shown. The pilot light indicates at every unit if the set has been turned on at any one of them.

Interstage Coupling for Screen-Grid Tubes

Successful Experiments with A Superhet Using Two 222-Type Tubes for the Stages of Intermediate-Frequency Amplification

By E. H. Rietzke and N. M. Cooke

MANY articles have been written on the theory and operation of the screen-grid tube; several circuits employing this tube are now on the market. Many of these circuits are plainly designed to take advantage only of the extremely low internal plate-to-grid capacity of this tube, thus avoiding undesirable feed back, but with little attempt to obtain the high amplification possible with a properly-designed circuit.

The writers have done considerable experimental work for the purpose of determining the most practical circuit to use for best results with this tube, particularly in the broadcast band. By good results we mean good reproduction, high amplification per stage, and sufficient selectivity.

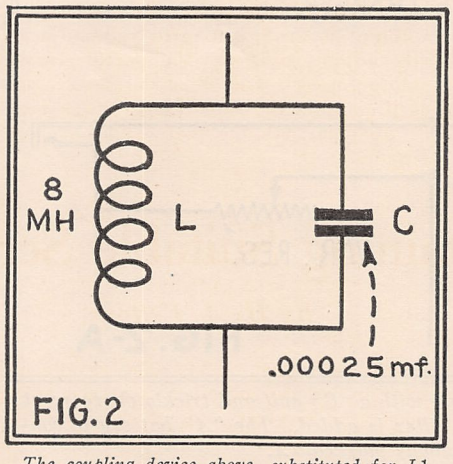
Dr. Hull, the designer of the American screen-grid tube, shows in his article, in the *Physical Review,* that he obtained the highest amplification and the most stable circuit at comparatively low frequencies. Experimental work with practical circuits has confirmed this for the writers. This fact, and the ease with which selectivity and simplicity of tuning may be obtained, are convincing arguments in favor of the superheterodyne type of receiver. Another determining factor in favor of the superheterodyne is the fact that a very-high-impedance circuit can be constructed to give uniform amplification over the entire broadcast band, or in fact over any desired frequency-band. The low intermediate frequency also makes the matching of the circuits a comparatively simple matter.

After determining the type of circuit to use the experimenter must decide the following points: how selective he wishes the receiver to be; how many stages of amplification he wishes to use; and the manner in which he is to obtain the desired selectivity.

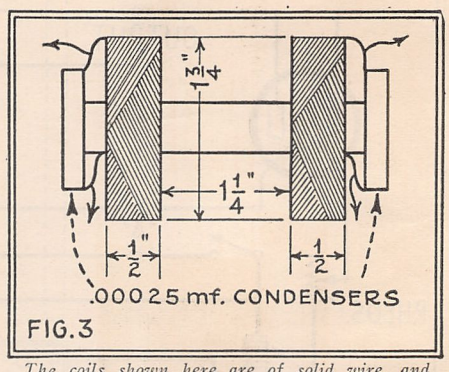
DESIGN OF THE CIRCUIT

The question of how many stages of amplification are desirable is simply a question of how efficient each stage is made. With the circuit design given later in this article, two stages give as much amplification as it is found practical to use with a short aerial. The amplification obtained with three stages brought the noise level too high for good broadcast reproduction.

The desired selectivity may be obtained in several ways. The band-pass filter with high impedance, and broadly-tuned interstage circuits, afford probably the ideal method of obtaining selectivity with a good quality of reproduction. Another circuit that will give good selectivity and good amplification with the screen-grid tube is a high-impedance, broadly-tuned plate circuit for the screen-grid tube, with a sharply-tuned input transformer ahead of the first intermediate amplifier. The third method is the use of a fairly-sharply-tuned circuit in each stage of intermediate-frequency amplification.



The coupling device above, substituted for L1 in Fig. 1, eliminates the need for an input filter.



The coils shown here are of solid wire, and therefore slightly smaller than the equivalent "Litz" coils described. The transformer peaks at 137 kc.

With proper design, all of the above methods will give excellent results; although the first two are somewhat better than the third circuit for broadcast reception. This is because several sharply-tuned circuits, while giving *high amplification,* make the circuit *too selective for good reproduction.* Some experimenters, however, prefer this type of circuit; so specifications will be given in this article for interstage coupling devices to be used with such a circuit.

LOW-LOSS CHARACTERISTICS

Interstage coupling circuits may be roughly divided into two classes, broadly-peaked and sharply-peaked. Both, when used with the screen-grid tube, must have a very highly resonant impedance; this is obtained by keeping the losses very low.

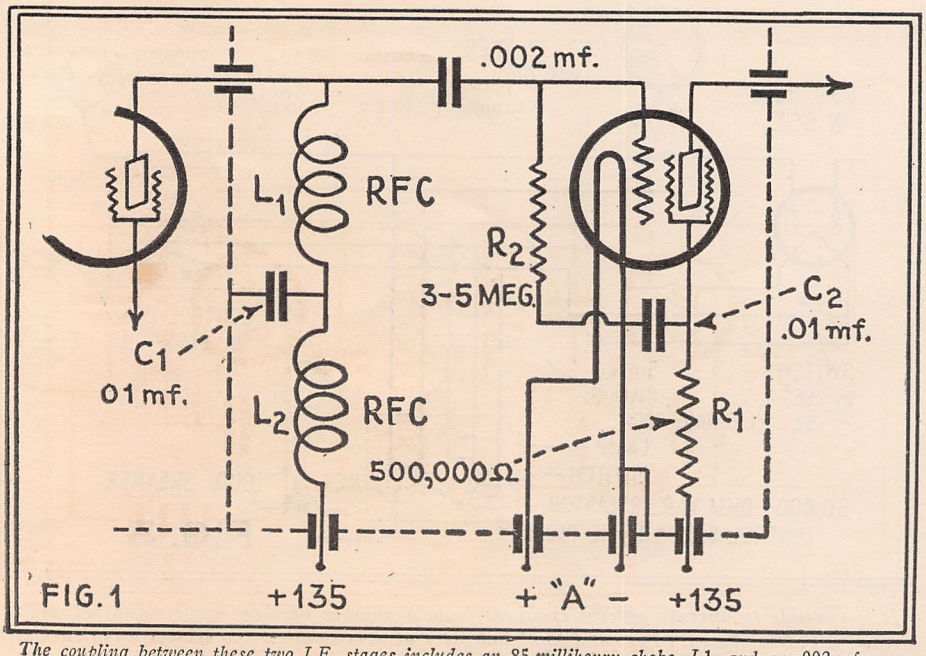
Since this is an absolute necessity if high amplification is to be obtained, the following circuits may all be assumed to be of the low-loss type.

Broad or sharp tuning in a parallel circuit depends upon the inductance-to-capacity ratio of the circuit. To make a circuit tune very broadly, the inductance-to-capacity ratio must be high. Conversely, to obtain very sharp tuning the inductance must be small and the capacity large.

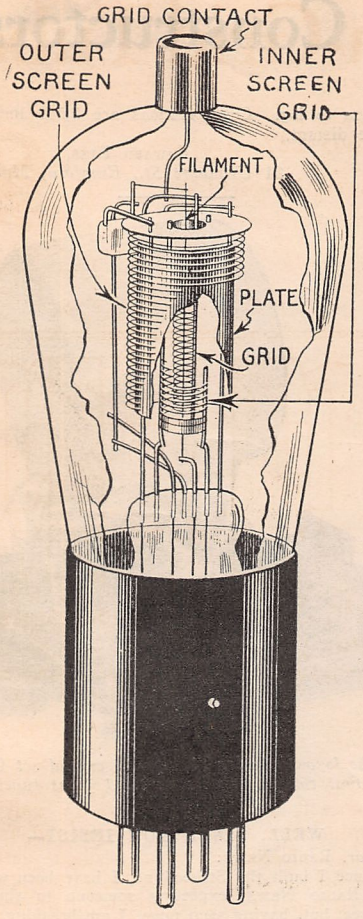
For the interstage coupling circuit between the screen-grid tubes, where a large inductance-to-capacity ratio is desired, there should be employed a helically-wound choke, which has an extremely small distributed capacity and a large value of inductance and at the same time a very low value of resistance; such as the Samson No. 85.

Thus this circuit meets the requirements of both high impedance and a broad peak.

Fig. 1 shows one stage of coupling between two screen-grid tubes using such a



The coupling between these two I.F. stages includes an 85-millihenry choke, L1, and an .002-mf. condenser. A suitably-tuned input must precede this I.F. amplifier, which is not selective.



The relative positions of the elements in the 222-type screen-grid tube.

choke (L1) and a .002-mf. condenser as the interstage coupling device.

A SHIELDING HINT

Another and similar choke L2, combined with the .01-mf. condenser C1, forms the filter in the plate-battery lead. This filter is placed just inside the shield and the condenser C1 is connected to the shield. When a common plate battery is used for all tubes—the ordinary condition—the filter in the plate leads must be used. It is well to mention here that the best results will be obtained if all connections to the shield are made *at the same point.* In this way the circulating currents in the shield will be greatly reduced and the effects of the shielding will be improved.

The correct value of grid leak to use with this circuit is found between three and five megohms, and the coupling capacity should be about .002-mf. Neither of these values is particularly critical, but in experimental work the best results were obtained with the values given.

SCREEN-GRID VOLTAGE

The 500,000-ohm resistor, R1, is used to obtain the correct value of positive potential upon the screen grid. The advantage of this method of obtaining the correct screen-grid voltage was discovered in transmitter work. It has been found that, with this resistor in the circuit and connected to the source of plate voltage, the voltage on the screen grid will automatically adjust itself for the particular plate voltage used. This is also advantageous, as it permits the same high-voltage tap to be used on both the plate and screen-grid circuits.

The condenser C2 (shown immediately above R1) should be connected directly from the screen-grid terminal to the negative filament terminal *on the socket.*

If it is not desired to use the resistance method of obtaining the correct screen-grid voltage, R1 may be replaced by another R.F. choke and the plate battery tapped at between 30 and 40 volts. (This value does not agree with the work of some experimenters who have been working with the UX-222 but, with this circuit, a screen voltage of from 30 to 40 volts gave considerably better results than the higher voltage usually used.)

It cannot be emphasized too strongly that, with the high amplification obtained from this type of circuit the interstage shielding must be as nearly perfect as possible.

The circuit described above is not in the least selective; so a tuned input transformer of some sort must be used to obtain the desired selectivity. The writers used an input transformer tuned to 137 kilocycles, and obtained excellent results with the chokes employed. A 50-kc. input was tried, but this frequency brought the noise level much too high for good reproduction. The 137-kc. tuned transformer is described below.

The coupling leads between stages *must* be shielded. Outside the shielding, excellent results can be obtained by using shielded ignition cable, grounding its shielding and making the holes in the interstage shields just large enough to force the shielded ignition cable through. *All* radio-frequency leads should be made as short as possible within the shields.

(*Continued on page* 81)

Methods of Obtaining Suitable Screen-Grid Voltage

By H. A. Pelton

THE theory of the screen-grid tube is now fairly well understood and many manufacturers and experimenters are engaged in a race to see what heights of amplification can be reached. Various circuits and shielding plans have been evolved, but one arrangement has remained unchanged, *i.e.,* the method of obtaining the positive bias on the screen-element.

The standard method has been to take off a tap, somewhere along the plate battery. This plan is very good, so long as the various batteries maintain constant terminal voltage; but consider what will happen after the set has been in use for some time and one or more of the battery units deteriorates. A set of screen-current and plate-current curves (plotted with fixed plate voltage and variable screen voltage, or with fixed screen voltage and variable plate voltage) will serve to show the difficulties which are sure to result if the ratio between the plate and shield voltages is not maintained within certain limits. It is true that this ratio is not extremely critical; but any service man can assure you that it is not at all unusual to find two identical batteries, connected in series for the same length of time, whose voltages differ as much as *ninety per cent.*

In addition, this method requires an extra lead, which must be brought out of the set through the already-crowded filter system and cable.

Why not, then, make some arrangement whereby we can obtain this screen voltage *inside* the receiver and, at the same time, maintain a fixed ratio between screen and plate voltages?

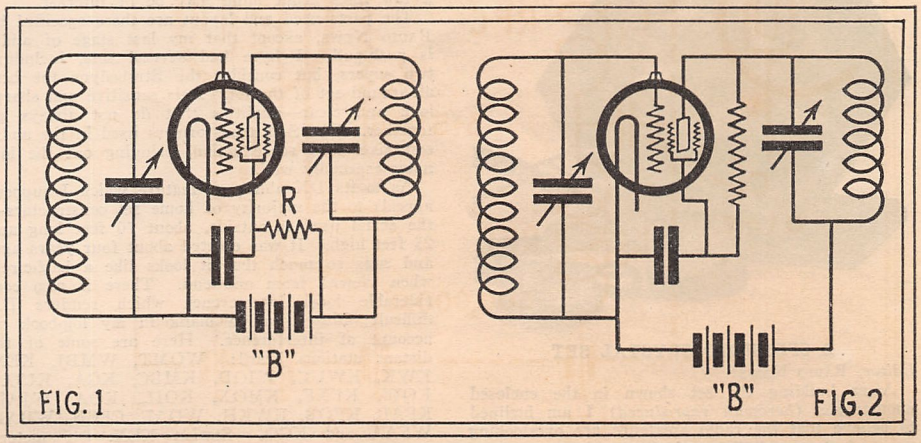
USE OF SERIES RESISTOR

Such a system is shown in Fig. 1. Here we are using a simple series resistor, R, to reduce the full plate voltage to the value required for the screen. Now, if the plate voltage varies for any reason, the screen voltage will also vary *in almost direct proportion.* In addition, we no longer require the extra screen-voltage lead to our batteries.

Since the ratio between plate and screen voltages is not extremely critical, it is evident that the size of the series resistor will not be critical and our work is simplified; since we can use a resistor of the standard size nearest to the indicated value.

For example: Curves of screen current

(*Continued on page* 81)



Figs. 1 and 2 show alternative methods of insuring automatically a proper voltage between screen-grid and plate. The latter is somewhat easier mechanically.

Letters from Home Radio Set Constructors

LINEN-SPEAKER DOPE

Editor, RADIO NEWS:

To use a parliamentary expression, may I rise to a point of order, to explain why collodion is (theoretically) unsuited for the purpose of coating a linen-diaphragm loud speaker? The writer has spent a lifetime in the drug business and has made and used collodion; I will say that it is a solution of nitrated cotton in alcohol and ether; the solvent is highly volatile, and when evaporated leaves a coating of cotton on the linen cloth; *it is not moisture-proof nor hard.* The speaker will vary its tone according to the amount of moisture it holds, and is highly inflammable, enough so to make it a hazard.

A "Duco" varnish should be used. Any automobile shop that does this work can spray the speaker with a lacquer and make a better job than with a brush. Lacquer, such as used on airplane wings, is *liquid celluloid;* that is, celluloid dissolved in acetone with amyl acetate ("banana oil" so called). If one cares to prepare it, dissolve the celluloid in the acetone, making it rather too thick to use, and thin with banana oil. This gives an almost translucent lacquer. Omitting the banana oil and thinning with acetone, makes a white-enamel finish.

Celluloid for this purpose may be had from some moving-picture place (old films). The image or photo impression can be removed by soaking the film in a solution of potassium carbonate, about ½ ounce to a half pint of water. A few hours in this will allow the film to be removed by scraping with a dull knife. Not removing the film would make a dull or opaque lacquer.

Celluloid is nitro-cotton, plus camphor and other ingredients that make it hard and impervious to water, and while inflammable, it is not nearly so easily ignited as collodion, and when ignited burns with less violence.

R. P. DANIEL,
South Park Pharmacy, San Antonio, Texas.

BUILDS SHORT-WAVE SETS FOR BOY SCOUTS

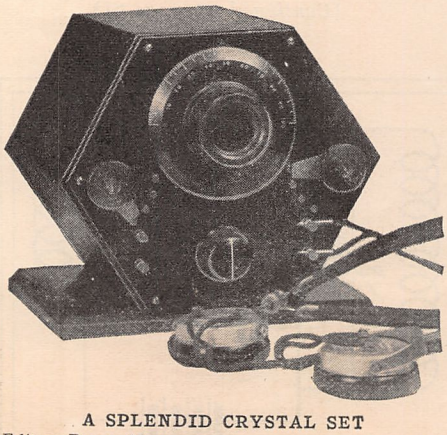
Editor, RADIO NEWS:

I have been having a lot of real enjoyment making short-wave sets.

It might be interesting to you to know that I have taught a number of Boy Scouts how to build sets and have made them learn the code. This has been play for them and has made it very easy to teach them to signal by "wig-wag." One of the things we are trying to do for the boys is to increase their powers of observation; and this certainly has done that. It was very easy to find boys who wanted to build sets, and to keep them interested I would tune in an amateur station who was sending code. This was a mystery to them until they learned the code and you can imagine the rest.

GEORGE O. HOWARD,
1736 *So. Xanthus Ave., Tulsa, Okla.*

(*In two senses, we may say this is constructive work. There is no better hobby for active, intelligent boys than short-wave radio; and we may commend Mr. Howard's example to Scout executives and all others interested in work for boys and young men.*—EDITOR.)



A SPLENDID CRYSTAL SET

Editor, RADIO NEWS:

After building the set shown in the enclosed photographs (*herewith reproduced*) I am inclined to believe that the radio amateurs are overlooking some of the possibilities of the crystal set. That shown was built around a carborundum stabilizing unit, and made as compact as possible. The hexagonal panel measures only seven inches across the flat sides, and the cabinet is only six inches deep. The reception is clear as a bell, and the selectivity made possible by the double tapping arrangement is good.

With this set connected to only a light-socket aerial, and an ordinary ground, I have listened to stations WGN, WSM, WBAP, WPG, WSAI, WGY and others. I can recommend such a set to anyone who has been doubtful about a fixed-crystal hook-up.

E. R. THOMPSON,
332 Orchard Street, Owensboro, Kentucky.

(*The merits of the crystal have been thrown into the shade since tubes became so good and cheap; but this example shows the possibilities which may be realized under the proper conditions. This little set represents more elaborate workmanship, and a specially-biased crystal, which are not found in the little "Beginner's" crystal set illustrated on page 33 of this issue; but the latter may be adapted as the skill of the constructor permits. Incidentally, Mr. Thompson reports reception of more than 750 miles, which can hardly be guaranteed with the best of crystal detectors.*—EDITOR.)

AN INSULATED GROUND

Editor, RADIO NEWS:

While experimenting with buried antennas, I buried three copper plates (insulated with rubber) to a depth of three feet, and attached the lead wire to the ground post of the receiver, with my 120-foot three-wire aerial remaining attached to the antenna binding post of the receiver. You can imagine my surprise to find stations rolling in with more volume than with the usual ground. And let me say that my ground system consists of five different grounds connected together, and includes buried pipes, zinc tins, galvanized wire, and boiler tubes driven into a septic tank (always wet). However, I can get better selectivity and better volume with the insulated ground. The plates are buried on edge, with a short ground lead to set.

JOHN G. BAIN,
R. R. 2, Ladysmith, B. C., Canada.

LETTERS for this page should be as short as possible, for so many are received that all cannot be printed. Unless a set is made from a published description, a schematic sketch should be sent; photos can be used only to illustrate a novelty, and then only if large and very clear. Inquiries for information not given here should be sent to the constructor direct; but he should NOT be asked to furnish data already published, here or elsewhere.

This department is for free discussion to the extent that space permits; but RADIO NEWS accepts no responsibility for the opinions of readers as to the relative merits of apparatus and circuits.

PRAISE OF THE STROBODYNE

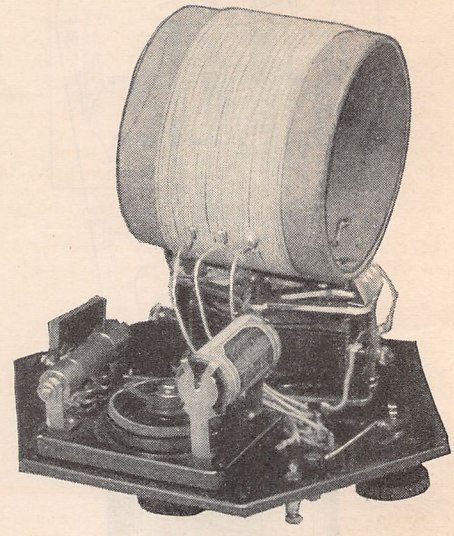
Editor, RADIO NEWS:

As I do not recollect seeing any mention of the Strobodyne in this department of late, I trust a few lines about mine may be of interest.

The parts used and layout are those specified by RADIO NEWS, except that my last stage of audio is push-pull. I have had several sets, including two supers, but consider the Strobodyne the best all-around set of the lot. It is sensitive and sharp, loud and clear—qualities that do not always go together. The S-M transformers used in the audio end give good reproduction, bringing out the low notes especially well.

As to its DX ability, a feature which I suppose appeals to the majority of home set constructors—the aerial used is outside, about 70 feet long and 25 feet high. It was erected about four years ago, and sags so much that it looks like a half-circle when viewed from one end. There is also considerable local interference which renders DX difficult; March was a blank in my log-book on account of interference. Here are some of the distant stations heard: WOMT, WMBJ, KEX, KWK, KWUC, WIOD, KMBC, KGA, KUOA, KQW, KFXF, KMOX, KOIL, KOA, WJAD, KFAB, KFQB, KWKH, WDAF, CFCN, WBAP, WFAA and KGO. Station KEX, 240 meters, was tuned in while WCAH (234 meters, but apparently higher) and WEDC (242 meters) were broadcasting. I have found KFI the easiest coast station to log. Coast stations are 2,500 miles or more distant.

EDWARD ETTS,
21 *Urquhart St., Rumford, Maine.*



The layout of Mr. Thompson's crystal set (see first column) on its six-sided front panel.

WELL, SINCE YOU INSIST—

Editor, RADIO NEWS:

Since I built the Strobodyne, I have been watching RADIO NEWS, expecting someone to sing its praises, but, having seen none, I am breaking away from the dials to speak for this "orphan." (*The "orphan" does not lack for friends. At least three thousand of these receivers have been constructed in this country alone, and evidently to the general satisfaction of their users. We merely feared that the subject might seem monotonous if given the full sway of this page*—EDITOR.) I had some trouble in adjusting this set but, with the kind assistance of Mr. Lacault, this difficulty was overcome. It was only a case of too much regeneration; I had the R.F. rheostat and potentiometer adjusted above the oscillation point.

Now let me tell you that the Strobodyne is a great set. When I think, sometimes, that I am listening to some Brooklyn station, I am "shocked" to hear the announcement come from some station a thousand miles away. This is what the Strobodyne will do any night: it will bring on the loud speaker *distant stations with* 10 *kc. separation when the locals are on.* One night last week I got to listening to WJZ at about 9:45 p. m., and began to move downward on the dials. The following stations came in, with more volume than some locals:

WJR, 441 meters; WLW, 428; WOR, 422; WGN, 416; CKAC, 411; WFI, 405; WTAM, 400; WHN, 394; WBBM, 389; WGY, 379; WSAI, 361; CKNC, 357; WIP, 349; WLS, 345; WSM, 337. When I came to WSM I was attracted by their old-fashioned music and stood by them the rest of the evening. I pick up the Coast any night, except on very bad ones. I use an aerial 45 feet long and 18 feet high.

As to quality of reproduction, I am satisfied to know that some of my friends who are musicians will sit and listen to the Strobodyne and count practically every instrument in an orchestra. Many thanks to RADIO NEWS for this wonderful circuit.

MARTIN PATREMIO,
93 *Burns Avenue, Lodi, New Jersey.*

TONING DOWN A HORN

Editor, RADIO NEWS:

I have done a little experimenting on horns and exponential speakers, but have found nothing that will equal my horn and cone together. First of all I am going to tell you how I fixed my loud speaker. It is very simple, as all you need is some candle tallow and a paint brush. Melt the tallow and apply on the inside of the bell of the speaker. If the unit of the speaker has a ringing sound, apply some of it on the inside of the cap. This, with the cone, gives a pleasing tone, so that you can hear every word of speech. I have built an exponential horn, described in RADIO NEWS, and it works fine, but I can't see that it does better than the combination I have.

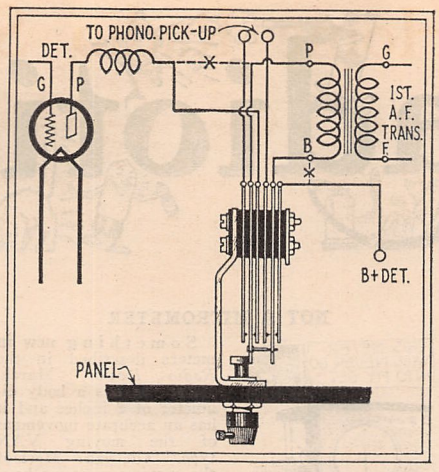
Some people think they are getting DX when they get Europe; but I think they will be sweating blood before they get KFSG, Los Angeles. I have talked with some people who have powerful sets and boast of KFI, but let them try and get the above station.

MURRAY COLEMAN,
Spring Valley, Minn.

A HANDY PHONOGRAPH SWITCH

Editor, RADIO NEWS:

I read an article in the April issue on how to make a permanent hook-up of a phonograph pick-up to a receiver. I am enclosing a diagram of how I have mine connected. My receiver is a five-tube affair, and I have it built into a large upright phonograph. I tore out the horn and record shelves; and in place of the former have a 7 x 18-inch panel; while in the record compartment I installed a stripped 18-inch Temple drum behind a home-made grille. I use a Pacent "Phonovox" and run the cord through the tone arm down to the pin jacks on the sub-panel. A snap of the switch on the radio panel allows the use of either phonograph or radio at will.



A convenient radio-phonograph combination switch

The parts required are one double-pole double-throw jack switch and two tip jacks. Cut the plate lead from the detector as indicated at one X in the diagram, and the "B+Det," as shown, at the other X. Extend the "B" lead on the first A.F. transformer to the second prong from the *top* of the jack; the "P" lead on the same to the second prong from the *bottom;* the "P" lead from the detector socket to the third prong from the bottom of the jack; and the "B+Det" lead from the battery to the top prong. The two remaining prongs are connected to the pin-tip jacks at the rear of the sub-panel for the pick-up connection. Either the radio or the phonograph can now be played at will by throwing the switch.

Perhaps some other fans would be glad to use this idea if you care to print it.

M. A. PORTER.

(*Will Mr. Porter send in his address?*—EDITOR.)

SUCCESSFUL DX EXPERIMENTS

Editor, RADIO NEWS:

I have experimented with different types of power tubes, and with wavetraps, and I find that

(*Continued on page* 89)

List of Broadcast Stations in the United States

(*Continued from page* 28)

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WJBU	Lewisburg, Pa.	214	100
WJBW	New Orleans, La.	238	30
WJBY	Gadsden, Ala.	234	50
WJBZ	Chicago Heights, Ill.	208	100
WJJD	Mooseheart, Ill.	**366	1000
WJKS	Gary, Ind.	232	500
WJR-WCX	†Pontiac, Mich. (Also 32 meters, 75 watts)	441	5000
WJZ	†New York, N. Y. (3XL, 59.96 meters, 30 k.w.)	**454	30,000
WKAQ	San Juan, Porto Rico.	322	500
WKAR	East Lansing, Mich.	278	*500
WKAV	Laconia, N. H.	224	50
WKBB	Joliet, Ill.	216	150
WKBC	Birmingham, Ala.	219	10
WKBE	Webster, Mass.	229	100
WKBF	Indianapolis, Ind.	252	250
WKBG	Chicago, Ill. (portable)	201	100
WKBH	La Crosse, Wis.	231	500
WKBI	Chicago, Ill.	216	50
WKBL	Monroe, Mich.	205	15
WKBN	Youngstown, Ohio.	214	50
WKBO	Jersey City, N. J.	219	500
WKBP	Battle Creek, Mich.	213	50
WKBQ	New York, N. Y.	219	500
WKBS	Galesburg, Ill.	217	100
WKBT	New Orleans, La.	252	50
WKBV	Brookville, Ind.	219	100
WKBW	Amherst, N. Y.	217	5000
WKBZ	Ludington, Mich.	200	15
WKDR	†Kenosha, Wis.	248	15
WKEN	†Buffalo, N. Y.	207	750
WKJC	Lancaster, Pa.	252	50
WKRC	Cincinnati, Ohio.	246	500
WKY	Oklahoma City, Okla.	288	150
WLAC	Nashville, Tenn.	225	5000
WLAP	Louisville, Ky.	268	500
WLB	Minneapolis, Minn.	246	500
WLBC	Muncie, Ind.	210	50
WLBF	Kansas City, Mo.	210	50
WLBG	Petersburg, Va.	214	100
WLBH	Farmingdale, N. Y.	232	30
WLBI	East Wenona, Ill.	238	250
WLBL	†Stevens Point, Wisc.	333	*1000
WLBM	Cambridge, Mass.	231	50
WLBN	Little Rock, Ark.	204	50
WLBO	Galesburg, Ill.	217	100
WLBQ	Atwood, Ill.	219	25
WLBR	Rockford, Ill.	248	15
WLBT	Crown Point, Ind.	248	50
WLBV	Mansfield, Ohio.	207	50
WLBW	Oil City, Pa.	294	500
WLBX	Long Island City, N.Y.	204	250
WLBY	Iron Mountain, Mich.	210	50
WLBZ	Dover-Foxcroft, Me.	208	250
WLCI	Ithaca, N. Y.	248	50
WLEX	Lexington, Mass.	216	50
WLIB	See WGN		
WLIT	Philadelphia, Pa.	405	500
WLOE	Chelsea, Mass.	211	100
WLS	†Chicago Ill.	**345	5000
WLSI	See WDWF		
WLTH	Brooklyn N Y.	256	250
WLTS	Chicago Ill.	484	100
WLW	†Cincinnati Ohio. (Also 52.02-49.96 meters 250 watts)	428	5000
WLWL	†Kearny, N. J.	370	5000
WMAC	Cazenovia, N. Y.	225	500
WMAF	So. Dartmouth, Mass.	428	500
WMAK	*Martinsville, N. Y.	545	750
WMAL	Washington, D. C.	242	500
WMAN	Columbus, Ohio.	234	50
WMAQ	*Chicago, Ill.	**447	*2500
WMAY	St. Louis, Mo.	234	100
WMAZ	Macon, Ga.	270	500
WMBA	Newport, R. I.	204	100
WMBB	†Chicago, Ill.	252	5000
WMBC	Detroit, Mich.	244	100
WMBD	Peoria Heights, Ill.	205	250
WMBE	WhiteBearLake, Minn.	208	10
WMBF	Miami Beach, Fla.	384	500
WMBG	Richmond, Va.	220	50
WMBH	Joplin, Mo.	204	100
WMBI	†Addison, Ill.	**263	5000
WMBJ	McKeesport, Penna.	232	50
WMBL	Lakeland, Fla.	229	100
WMBM	Memphis, Tenn.	210	10
WMBO	Auburn, N. Y.	220	100
WMBQ	Brooklyn, N. Y.	204	100
WMBR	Tampa, Fla.	252	100
WMBS	Lemoyne, Pa.	234	250
WMBW	Youngstown, Ohio.	214	50
WMC	Memphis, Tenn.	547	5000
WMCA	†New York, N. Y.	370	500
WMES	Boston, Mass.	211	50
WMPC	Lapeer, Mich.	234	30
WMRJ	Jamaica, N. Y.	207	10
WMSG	New York, N. Y.	236	500
WNAC-WBIS	Boston, Mass.	461	500
WNAD	Norman, Okla.	240	500
WNAL	Omaha, Neb. (Also 105 meters, 50 watts)	258	250
WNAT	Philadelphia, Pa.	288	100
WNAX	Yankton, S. D. (day).	303	1000
WNBA	Forest Park, Ill.	208	200
WNBF	Endicott, N. Y.	207	50
WNBH	New Bedford, Mass.	261	250
WNBJ	Knoxville, Tenn.	207	50
WNBO	Washington, Pa.	211	15
WNBQ	Rochester, N. Y.	205	15
WNBR	Memphis, Tenn.	229	100
WNBT	Elgin, Ill. (time sigs.).	35.5	500
WNBW	Carbondale, Pa.	200	5
WNBX	Springfield, Vt.	242	10
WNBZ	Saranac Lake, N. Y.	232	10
WNJ	Newark, N. J. (Has short-wave transmitter)	268	250
WNOX	Knoxville, Tenn.	265	1000
WNRC	Greensboro, N. C.	224	250
WNYC	New York, N. Y.	526	500
WOAI	San Antonio, Tex.	280	5000
WOAN	Lawrenceburg, Tenn.	240	500
WOAX	Trenton, N. J.	240	500
WOBR	Shelby, Ohio (portable)	204	10
WOBT	Union City, Tenn.	205	15
WOBU	Charleston W. Va.	268	250
WOC	Davenport, Iowa.	375	5000
WOCL	Jamestown, N. Y.	224	25
WODA	Paterson, N. J.	294	1000
WOI	Ames, Iowa.	265	*1000
WOK	See WMBB		
WOKO	Beacon, N. Y.	216	500
WOKT	Rochester, N. Y.	210	500
WOMT	Manitowoc, Wis.	222	100
WOO	Philadelphia Pa.	349	500
WOOD	†Grand Rapids, Mich.	261	500
WOQ	Kansas City, Mo.	341	500
WOR	†Kearny, N. J. (Also 65.4 meters, 50 watts)	422	5000
WORD	†Batavia, Ill.	252	5000
WOS	Jefferson City, Mo.	422	500
WOW	Omaha, Nebr.	508	1000
WOWO	Fort Wayne, Ind. (Also 22.8 meters, 1000 watts)	229	*2500
WPAP	See WQAO		
WPCC	Chicago, Ill.	224	500
WPCH	†New York, N. Y.	326	500
WPEP	Waukegan, Ill.	216	250
WPG	Atlantic City, N. J.	273	5000
WPRC	Harrisburg, Pa.	210	100
WPSC	State College, Pa. (day)	300	500
WPSW	Philadelphia, Pa.	207	50
WPTF	Raleigh, N. C.	545	1000
WQAM	Miami, Fla.	384	750
WQAN	Scranton, Pa.	231	250
WQAO-WPAP	†Cliffside, N. J.	395	500
WQBA	Tampa, Fla.	238	250
WQBC	Utica, Miss. (day).	216	225
WQBJ	Clarksburg, W. Va.	240	65
WQBZ	Weirton, W. Va.	250	60
WQJ	Chicago, Ill.	447	500
WRAF	Laporte, Ind.	208	100
WRAH	Providence, R. I. (Has short-wave transmitter)	200	250
WRAK	Erie, Pa.	219	30
WRAM	Galesburg, Ill.	248	50
WRAW	Reading, Pa.	238	100
WRAX	Philadelphia, Pa.	213	250
WRBC	Valparaiso, Ind.	238	250
WRBH	Manchester, N. H.		500
WRBI	Tifton, Ga.		50
WRBJ	Hattiesburg		10
WRBL	Columbus, Ga.		50
WRBQ	Greenville, Ga.		100
WRBT	Wilmington, N. C.		50
WRBU	Gastonia, N. C.		50
WRBW	Columbia, S. C.		15
WRBX	Richmond, Va.		250
WRC	Washington, D. C.	**468	500
WREC	†Memphis, Tenn.	250	500
WREN	Lawrence, Kan.	254	750
WRES	Quincy, Mass.	217	50
WRHF	Washington, D.C. (day)	322	150
WRHM	†Minneapolis, Minn.	261	1000
WRM	Urbana, Ill.	273	500
WRK	Hamilton, Ohio.	205	100
WRMU	New York, N.Y. (port.) (2XAO, ship, 105.9 meters, 100 watts)	201	100
WRNY	†New York, N. Y. (Also 30.91 meters, 500 watts)	326	500
WRR	Dallas, Tex.	461	500
WRRS	Racine, Wis.	248	50
WRST	Bay Shore, N. Y.	211	150
WRUF	Gainesville, Fla.	203	5000
WRVA	Richmond, Va.	254	1000
WSAI	†Cincinnati, Ohio.	361	5000
WSAJ	Grove City, Pa.	224	250
WSAN	Allentown, Pa.	222	100
WSAR	Fall River, Mass.	213	250
WSAX	Chicago, Ill. (port.)	204	100
WSAZ	Huntington, W. Va.	250	100
WSB	Atlanta, Ga.	476	1000
WSBC	Chicago, Ill.	232	500
WSBF	St. Louis, Mo.	258	250
WSBT	South Bend, Ind.	400	500
WSDA	See WSGH		
WSEA	Portsmouth, Va.	263	500
WSGH	Brooklyn, N. Y.	227	500
WSIX	Springfield, Tenn.	250	150
WSKC	Bay City, Mich.	273	250
WSM	Nashville, Tenn.	337	5000
WSMB	New Orleans, La.	297	750
WSMK	Dayton, Ohio.	297	200
WSPD	Toledo, Ohio.	240	250
WSRO	Middletown, Ohio.	236	100
WSSH	Boston, Mass.	288	100
WSUI	Iowa City, Ia. (day)	476	500
WSUN	St. Petersburg, Fla.	517	750
WSVS	Buffalo, N. Y.	204	50
WSYR	Syracuse, N. Y.	294	500
WTAD	Quincy, Ill.	236	*250
WTAG	Worcester, Mass.	517	250
WTAM	Cleveland, Ohio	**400	*3500
WTAQ	Eau Claire, Wis.	254	500
WTAR-WPOR	Norfolk, Va.	236	500
WTAS	Elgin, Ill.	275	500
WTAW	College Station, Tex.	484	500
WTAX	Streator, Ill.	248	50
WTAZ	Richmond, Va.	220	15
WTFF	Mt. Vernon Hills, Va.	203	10,000
WTFI	Toccoa, Ga.	210	500
WTHS	Atlanta, Ga.	227	200
WTIC	Hartford, Conn.	535	500
WTMJ	Milwaukee, Wis.	294	1000
WTRL	Midland Park, N. J.	207	15
WWAE	Chicago, Ill.	227	500
WWJ	Detroit, Mich.	353	1000
WWL	New Orleans, La.	246	500
WWNC	Asheville, N. C.	297	1000
WWRL	†Woodside, N. Y.	200	100
WWVA	Wheeling, W. Va.	517	250

*Allowed higher daylight power. **Standard or constant-frequency transmission. †Remote Control.

LIST OF CANADIAN BROADCAST CALLS

CFAC	Calgary, Alta.	435	500
CFBO	St. John, N. B.	337	50
CFCA	Toronto, Ont.	357	500
CFCF	Montreal, Que.	411	1650
CFCH	Iroquois Falls, Ont.	500	250
CFCN	Calgary, Alta.	435	1800
CFCQ	Vancouver, B. C.	411	10
CFCT	Victoria, B. C.	476	500
CFCY	Charlottetown, P.E.I.	312	100
CFGC	Brantford, Ont.	297	50
CFJC	Kamloops, B. C.	268	15
CFLC	Prescott, Ont.	297	50
CFMC	Kingston, Ont.	268	20
CFNB	Fredericton, N. B.	248	25
CFQC	Saskatoon, Sask.	330	500
CFRB	Toronto, Ont.	517	1000
CFRC	Kingston, Ont.	268	500
CFYC	Burnaby, B. C.	411	500
CHCA	Cagary, Alta.	435	250
CHCS	Hamilton, Ont.	341	10
CHCT	Red Deer, Alta.	357	1000
CHCY	Edmonton, Alta.	517	250
CHGS	Summerside, P. E. I.	268	25
CHIC	Toronto, Ont.	357	500
CHMA	Edmonton, Alta.	517	250
CHML	Mt. Hamilton, Ont.	341	50
CHNC	Toronto, Ont.	357	500
CHNS	Halifax, N. S.	322	100
CHPC	Vancouver, B. C.	411	1000
CHRC	Quebec, Que.	341	5
CHSC	Unity, Sask.	268	50
CHUC	Saskatoon, Sask.	330	500
CHWC	Regina, Sask.	312	15
CHWK	Chilliwack, B. C.	248	5
CHYC	Montreal, Que.	411	750
CJBC	Toronto, Ont.	517-357	500
CJBR	Regina, Sask.	312	500
CJCA	Edmonton, Alta.	517	500
CJCJ	Calgary, Alta.	435	250
CJCR	Red Deer, Alta.	357	1000
CJGC	London, Ont.	330	500
CJGX	Yorkton, Sask.	476	500
CJOC	Lethbridge Alta.	268	50
CJOR	Sea Island, B. C.	291	50
CJRM	Moose Jaw, Sask.	297	500
CJSC	Toronto, Ont.	357	500
CJWC	Saskatoon, Sask.	330	250
CJYC	Toronto, Ont.	517	500
CKAC	Montreal, Que.	411	1200
CKCD	Vancouver, B. C.	411	1000
CKCI	Quebec, Que.	341	23
CKCK	Regina, Sask.	312	500
CKCI	Toronto, Ont.	357	500
CKCO	Ottawa, Ont.	435	100
CKCR	St. George, Ont.	258	25
CKCV	Quebec, Que.	341	50
CKCX	Toronto, Ont.	517	500
CKFC	Vancouver, B. C.	411	50
CKGW	Bowmanville, Ont.	312	5000
CKLC	Red Deer, Alta.	357	1000
CKMC	Cobalt, Ont.	248	5
CKNC	Toronto, Ont.	357	500
CKOC	Hamilton, Ont.	341	100
CKOW	Toronto, Ont.	517	500
CKPC	Preston, Ont.	248	8
CKPR	Midland, Ont.	268	50
CKSH	St. Hyacinthe, Que.	297	50
CKSM	Toronto, Ont.	517	1000
CKUA	Edmonton, Alta.	517	500
CKWX	Vancouver, B. C.	411	50
CKY	Winnipeg, Man.	384	500
CNRA	Moncton, N. B.	476	500
CNRC	Calgary, Alta.	435	500
CNRE	Edmonton, Alta.	517	500
CNRM	Montreal, Que.	411	1650
CNRO	Ottawa, Ont.	435	500
CNRQ	Quebec, Que.	341	50
CNRR	Regina, Sask.	312	500
CNRS	Saskatoon, Sask.	330	500
CNRT	Toronto, Ont.	357	500
CNRV	Vancouver, B. C.	291	500
CNRW	Winnipeg, Man.	384	500

TELEGRAPH OR PIANO?

Interesting item from the *Charlotte (N.C.) Observer* of March 30th: "Station WBT is at present operating on 1,160 KEYS, 1,000 watts power." If it means that the station works on this number of telegraph keys, that will be news; but if it operates on 1,160 different musical keys, that will be agony.

Contributed by our old friend Anonymous.

HEY, MIKE, GET BUSY!

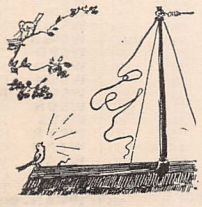
Herewith some excellent advice from *Harry Alter's Radio Book* for April 1928: "Buy this BOO and your service will improve." We sent Mike of the Investigation Dept. around to find us a boo or two; for some of our apparatus hasn't been giving us such good service, lately, despite the many boos the baby tosses at it.—*Contributed by Ruford W. Watson*

C'MON, YOU VOLTS!

Pre-season football practice noted by the *Radio World* of Feb. 4: "One Powerful New Amplifier Tube BOOTS Signal Strength in Circuit." The Amps and the Volts will have a wild time playing each other this season, with so much resistance affecting both elevens. Yey, Volts, kill these Amps! !

Contributed by George McArdle

SPRIG HAD CUB



Vernal gesture from the *Chicago Apparatus Company's* catalog: "The masts are rust-proof and each one is equipped with three roof anchors, 50 feet galvanized GAY wire and a pulley." The flowers that bloom in the spring, tra la, remind the broadcast fan that housecleaning is now due; this goes for the aerial equipment as well.—*Contributed by Caesar Crosby.*

YOU MUST COME OVER!

Queer program number found in the *Boston Post* of March 18: "3:00 P.M. —Beethoven MALE Quartet. Etta M. Bradley, Soprano; Clara Killius, Contralto; W. D. Broadbent, tenor; M. J. Dickinson, bass." Perhaps radio male quartets are different from those ordinarily found in churches and theatres, eh?

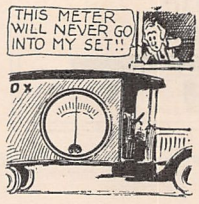
Contributed by E. E. Gould

WE WANNA GO!

A warm time promised by the *Springfield (Ohio) Sun* of March 6: "Thursday at 6:30 P.M. the Sunset Boys are scheduled to broadcast a SINNER dance program. A MAIL quartet are included in this special entertainment." This sounds like those parties that Nero used to throw; or maybe it was King Arthur, if the quartet is in mail.

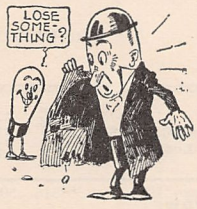
Contributed by Ollie Meloay

NOT A MICROMETER



Something new in meters described in the *Radio Dealer,* March, 1928: "It has a body diameter of 2 inches and it has an accurate movement of the moving VAN type." Oh, yeh? Most of the moving vans we have met—to our sorrow—would hardly fit into anything two inches in diameter. However, live and learn.—*Contributed by W. F. Gamble*

OUR COIN FALLS OUT AT THE TOP



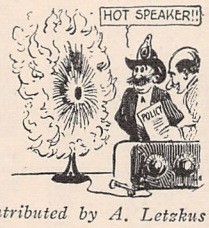
In the *New York Telegram* of March 24th we find specified, in a list of parts for an amplifier, the peculiar item "Two UX POCKETS." These must be the kind that develop after a suit has worn four or five years. You know the kind — four holes through which everything drops.

Contributed by B. B. Bryant

IF you happen to see any humorous misprints in the press we shall be glad to have you clip them out and send to us. No RADIOTIC will be accepted unless the printed original giving the name of the newspaper or magazine is submitted, with date and page on which it appeared. We will pay $1.00 for each RADIOTIC accepted and printed here. A few humorous lines from each correspondent should accompany each RADIOTIC. The most humorous ones will be printed. Address all RADIOTICS to

Editor, RADIOTIC DEPARTMENT,
c/o Radio News.

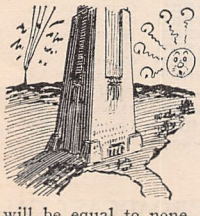
UNLESS IT'S FIREPROOFED



A rather warm one found in the *Memphis Commercial Appeal* of April 8, "It consists of two linen diaphragms stretched upon FLAMES with the centers drawn in towards each other." We're willing to wager the weekly pay-check against the w.k. doughnut that the timbre of this speaker isn't so much.

Contributed by A. Letzkus

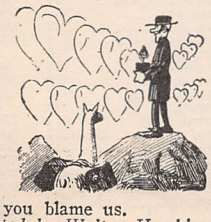
E PLURIBUS UNUM



The New South asserts itself, according to the *Jasper (Alabama) Eagle,* which chronicles the prospective establishment of a "5000 KILOWATT station in Birmingham that will be the equal of any station in America." As no station has now more than a fiftieth as much power, candor compels us to assert that this station will be equal to none.

Contributed by Wood-Rowe Purcell

IN THE SPRING A YOUNG MAN'S FANCY—



Erotic motif in the *South Bend (Ind.) News-Times* of Feb. 26: "Rev. Clarence W. Jones is on his way to South America where he will locate a site for a LOVE-WAVE radio link to WJBT." Mike of the Investigation Dept. wanted to go down as a helper when he heard what kind of a station was going up; but we decided to go ourselves. Do you blame us.

Contributed by Walter Hawkins

A REAL INVENTION

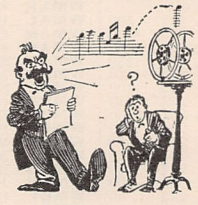
Help for the weary diner-out is promised by the advertising columns of the *Barnsville (Ohio) Whetstone* of March 9: "FOR SALE — Famous Radiola 16, six-tube, single dial, SUPPER SELECTIVE. Costs $145, will sacrifice for $175." Seems as though these prices are a bit out, but if it will provide our dinner it is worth the cash.

Contributed by Ollie Meloay

SLIDE, KELLY, SLIDE!

Scientific announcement from the *Lansing (Mich.) Journal* of March 14, to the effect that ". . . . the famous HEAVY SLIDE layer in the atmosphere, 30 to 50 miles up," is "comparatively low down." This must be something like the slides they have at Coney Island. Now we know what happens to some of the radio waves; they're sliding around upstairs some place.—*Contributed by R. C. Ditto*

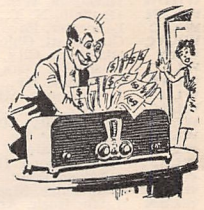
THAT AIN'T NO LADY—



This from the April 7th issue of *Radio Doings*: "The trio is under the direction of Kola Levienne and has as one of its members MR. J. Webster Hoover, MEZZO-SOPRANO, director of programs for KJR." According to our way of thinking, there are plenty of female sopranos without the men horning in.

Contributed by Brayton Shoven

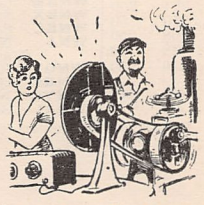
WE NEED THEE EVERY HOUR



Financial note from the *Indianapolis Star* of March 18: "The WLW BANKBOX hour will open at 8:15 this evening." Our readers who were anxious to catch KMOX broadcasting checks (of the chess-playing and non-negotiable variety) were tuned in, we hope, at the right time to collect a few pleasant souvenirs of the occasion.

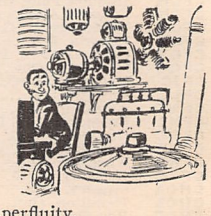
Contributed by Caesar Crosby

A POSITIVE DRIVE



Fashion note from the *New York Sun* of April 7: "Workrite radio in beautiful console with BELT IN cone speaker." Whether this belt is intended as a power-transformer device for the speaker, or merely to hold its diaphragm from slipping off, we do not know; but in either event, it should be helpful on the low notes.—*Contributed by G. Bravard.*

ATTENTION, HAMS!



Transmitting wrinkle found in the *Milwaukee Telegram's* "Radiolog": "An eighty MOTOR wave was found good for ranges of 50 to 1,000 miles. If an operator using a low-power transmitter on eighty MOTORS wishes to communicate—" We wish to inform the experimenting fraternity, however, that this degree of luxury involves some superfluity.

Contributed by John Hopwood

Conducted by C. W. Palmer

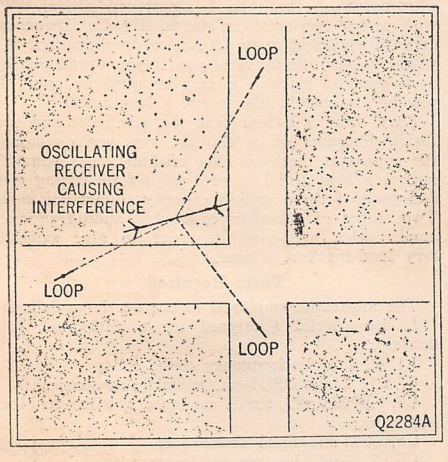
RADIO NEWS ***readers send in every month an average of*** **5000** ***letters asking information on every phase of radio theory, construction and operation. We can only print the five or six replies which are of widest general interest.***

Other letters will be answered by mail, if inquirers observe these rules: BE BRIEF: TYPEWRITE OR WRITE LEGIBLY IN INK ON ONE SIDE OF THE SHEET ONLY: ENCLOSE A STAMPED ENVELOPE ADDRESSED TO YOURSELF. ***Many letters are not readable. Simple questions will be answered free; those asking for sketches, diagrams, data, etc., should send*** TWENTY-FIVE CENTS FOR EACH QUESTION: ***failure to enclose this will cause delay. We cannot answer for this sum questions requiring original research, intricate calculation, or patent investigation; we cannot compare the merits of trademarked apparatus, or give constructional data on apparatus whose makers withhold it. We cannot undertake to answer more than*** THREE QUESTIONS ***in each letter. If you inquire concerning a circuit which is not a standard, published one, enclose a diagram to save delay.***

LOCATING INTERFERENCE

(Q. 2284). Mr. C. G. Shattuck, Juneau, Alaska, writes: "Radio fans in this city have recently organized the Juneau Radio Club, with the perfection of local reception and the education of radio owners, so they will be able to better understand their sets, as our aims.

"It was brought up at a meeting, some days ago, that your magazine answered questions asked by fans. We would like information on the instruments best adapted for finding squealers and other local interference sources.



The source of the sound is where the loudest loop readings center. It may be found more accurate to take loop readings at points of least audibility, and lay off bearings at right angles to the loop.

"We would be glad to hear from you on this matter, as interference is sometimes very bad here, and your help would mean a great deal to us."

(A.) When locating oscillating receivers and other sources of interference, such as you mention above, it is necessary to use a receiver which is entirely portable, yet sensitive enough and selective enough to pick up signals from only one direction with a loop aerial. The set employed for this purpose must be completely self-contained, including batteries and all other equipment except the loop aerial. The cabinet enclosing the apparatus must be completely shielded, top, bottom and sides, with no openings at any point.

A receiver for this purpose may comprise only one stage of tuned-radio-frequency amplification, a non-regenerative detector, and one audio-frequency stage as shown in Q. 2284. Of course, it is not necessary to use a receiver of exactly this type; since any shielded set which is sufficiently sensitive and portable will serve. The receiver illustrated employs two tuning condensers, .0005-mf. capacity, and a tuning inductor with 10 turns for the primary and 50 for the secondary, both wound on a single 3-inch tube with about ¼-inch spacing between the two coils. A loop aerial sixteen inches square with 15 turns of No. 20 or larger wire with ¼-inch spacing between turns will be satisfactory. The values of the other apparatus are all indicated on the diagram. The "B" voltage should be between 45 and 90; small "B" batteries should be employed, since the receiver has to be portable in order to be of service.

"Triangulating"

In operation, the receiver is either carried or transported in an automobile, and the loop aerial is revolved until the sound of the interference is at its maximum volume. The loop aerial is then pointed directly at the antenna of the interfering set or other source of interfering noise. This operation should be repeated from several points, as shown in Fig. Q. 2284A. By laying off lines in the direction of greatest signal strength from each of the three or four points, the exact position of the source of the interference can be found.

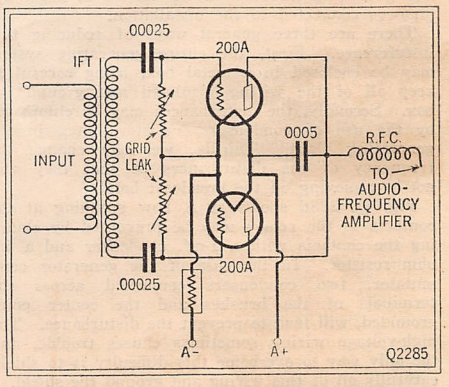
The receiver should then be taken close to this indicated point, and moved around while the loop is rotated. It will finally be possible to move the receiver all the way around one location, with the loop continually pointed towards the center of this small area. The cause of the trouble is somewhere near this point. It is then a simple task to locate the exact source of the interfering noise.

Types of Noises

Beside the regular howl of an oscillating receiver, there are several other noises which can be recognized when employing this device. Rapid and regular clicking noises can, usually, be attributed to vibrating battery chargers or other electrical devices which employ vibrators. Intermittent rasping and scratching noises which vary in intensity may be caused by defective insulators or loose contacts in power lines. A more or less steady and continual crackling noise may come from arc lamps or some types of medical devices employing heating coils or arcs. A rapid whirring noise is usually caused by sparking at the contacts of commutators in motors, generators, etc. Crackling noises which occur at regular intervals are generally due to electric sign flashers. There are several other noises which can be recognized, but the above are the most common. Of course, the rather musical long and short dashes which are often heard in receivers, are due to radio-telegraph stations, on land or sea. These are usually found on the longer wavelengths.

STROBODYNE DATA

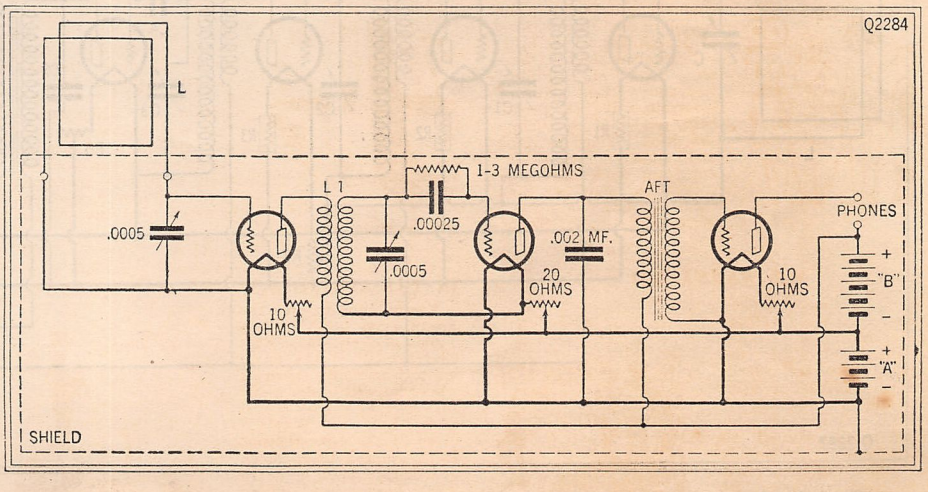
(Q. 2285). Mr. A. J. Drummer, Baltimore, Md., writes: "Please answer the following questions in the next available issue of RADIO NEWS. At which frequency are peaked the long-wave transformers which are employed in the Strobodyne receiver? Would it be of advantage to use two stages of radio-frequency amplification before the Strobodyne receiver instead of one? Would it be advisable to employ a push-pull detector, like that in the enclosed diagram, in the second detector circuit? Should the 201A-type tube be employed;



Circuit of a push-pull second detector, suited to the Strobodyne and other receivers with 120-kc. I.F. amplification.

and should the grid return be to "A—" or "A+"?

(A.) The intermediate-frequency transformers employed in the Strobodyne receiver are tuned to a frequency of 120 kilocycles when the secondary coil



Circuit of a three-tube portable set, adapted especially for the detection of "bloopers" and other sources of interference. It must be completely shielded, as indicated. See the text for coil data.

is shunted by a fixed condenser of .00025-mf. capacity. The exact frequency, of course, depends upon the accuracy of the condensers across the secondary; and these condensers must be matched very carefully, so that each of the intermediate-frequency transformers will be tuned to the same frequency.

We would not suggest that you try to use two stages of radio-frequency amplification before the Strobodyne receiver, since this would involve the use of too many tuning controls and, if the tuning condensers were ganged together, difficulty would be encountered in keeping the circuits exactly in resonance. The use of this extra stage would increase the size of the receiver considerably, too; since it would be necessary to shield both radio-frequency stages in order to obtain good results.

If you desire, you can employ a push-pull second detector in your set by the method that you suggest. (For the benefit of other readers, we are printing the diagram to which Mr. Drummer refers, since this should be of interest to many other fans). If the 200A tube is used, it will be necessary to connect the grid return to the "A—". If 201A tubes are employed, the grid return should be connected to the positive "A" battery terminal. In order to obtain good results with this detector system, it will be necessary to have tubes which are matched closely, and also to adjust carefully the grid leaks; since the resistance on each side of the connection running to the filament must be exactly the same, in order to keep the grid bias on each tube at the same value.

FARM-LIGHTING INTERFERENCE

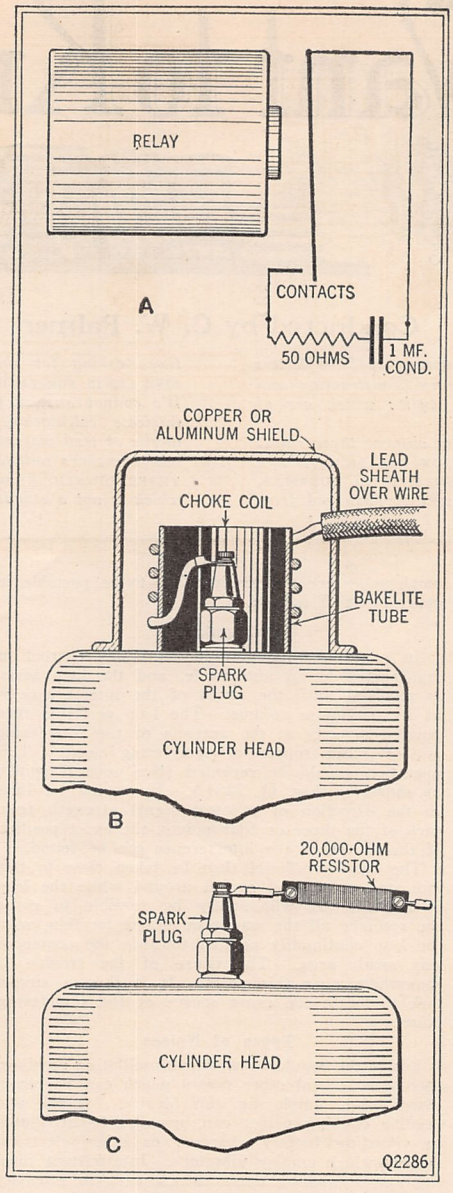
(Q. 2286). Mr. A. F. Jensen, Stamford, Conn., writes: "We are having quite a lot of trouble with our radio receiver, because the 32-volt lighting installation which we are using causes a lot of interference. Since there are a number of relays and spark gaps in this installation, we are at a loss to know how to reduce this noise."

(A.) The interference caused by a Delco or similar generating plant may be caused by the spark at the spark plug of the gasoline engine, sparking at the distributor, sparking at the relays and governing mechanisms, or motors or other appliances connected to the installation.

There are three general ways of reducing this interference. First, the entire generating system may be enclosed in a metal box, being careful to keep all of the wiring insulated and ground the box. Secondly, the disturbances may be eliminated by the use of condensers, resistors, etc., in the generating plant. Thirdly, we may change the frequency of the disturbances so that they will not be annoying on the broadcast band.

Fig. Q. 2286 shows at A how sparking at the contacts in the relays may be prevented by shunting the contacts with a 1-mf. condenser and a 50-ohm resistor. In the case of the generator commutator, two condensers connected across the terminals of the brushes and the center point grounded, will tend to prevent the disturbance. The high-voltage wiring sometimes causes trouble, and the only way to overcome this difficulty is to shield carefully all of this wiring and ground the shield.

Disturbances from the spark plug are sometimes more severe on some wavelengths than others.



Several methods for overcoming interference caused by farm-lighting plants are shown above. At B is shown the method of constructing a coil which is used for the purpose of changing the frequency of the interference caused by the spark system. In this way it does not interfere with reception on the broadcast band.

Fig. 2286B shows how a shielded choke coil can be connected in the circuit to overcome this difficulty by changing the wavelength of the disturbance. A choke coil for this purpose may be wound with a few turns of No. 16 wire on a form 1½ inches in diameter, and a small can mounted over it. In some cases, a carbon resistor of about 20,000 ohms can be used as shown at C in place of the choke coil. In this case, the shield is not necessary. This method suppresses the interference rather than changes the wavelength.

It may be advisable, in some cases, to shield both the high-voltage wiring running from the spark plug to the high-voltage distributor, and the low-voltage wiring from the distributor to the generator, in order to reduce the volume of the noises.

The methods mentioned above will be satisfactory for overcoming disturbances caused by the lighting installation itself but, naturally, these suggestions will not overcome interfering noises *caused by apparatus connected to the line.* These noises come from a number of different types of apparatus, including fans, vacuum cleaners, violet-ray machines, irons, percolators, motors, X-ray machines, etc. We would suggest that you read the article in the March issue of Radio News entitled "How to Kill Vagrant Radio Noises" in order to overcome difficulties of this sort. A very interesting booklet on this subject has been prepared by the Radio Manufacturers Association, 1265 Broadway, New York City and may be obtained from this organization for 25 cents.

A SIX-TUBE RECEIVER

(Q. 2287). Mr. A. Klein, St. Louis, Mo. writes:

(Q.) "I am writing for a class of thirty-eight pupils at our school. We have bought quite a number of 17-plate straight-line condensers and also basket-weave coils of the Freshman type. Each of us wishes to build a radio receiver, one for each room in our school. We have decided on a five- or six-tube set, using three coils and condensers of the type I mentioned above. We wish to use two or three stages of radio frequency, and two stages of audio-frequency amplification. We would be very thankful to you if you would publish a diagram of such a circuit or send us one. If possible, we would like to use a loop aerial."

(A.) You will find here the schematic and pictorial diagrams of a six-tube receiver employing the apparatus that you have on hand. As you will notice, a loop aerial is used with four tuning condensors and three radio-frequency inductance coils. Two stages of transformer-coupled audio-frequency amplification are used in order to give satisfactory loud-speaker volume.

Parts Required

The apparatus employed in the set is as follows:

L, loop aerial (designed for a .00035-mf. condenser);

L1, 2, 3, radio-frequency choke coils;

C, C1, 2, 3, .00035-mf. variable condensers;

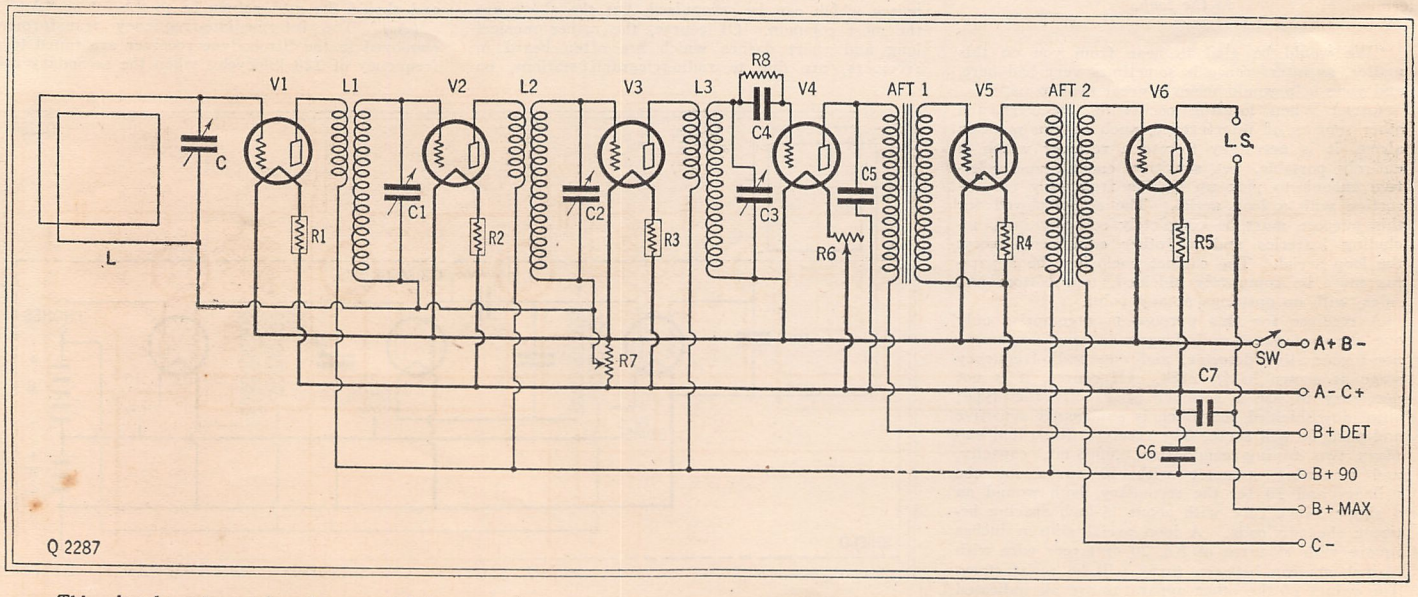
C4, .00025-mf. fixed condenser, with grid-leak mounting;

C5, .002-mf. fixed condenser;

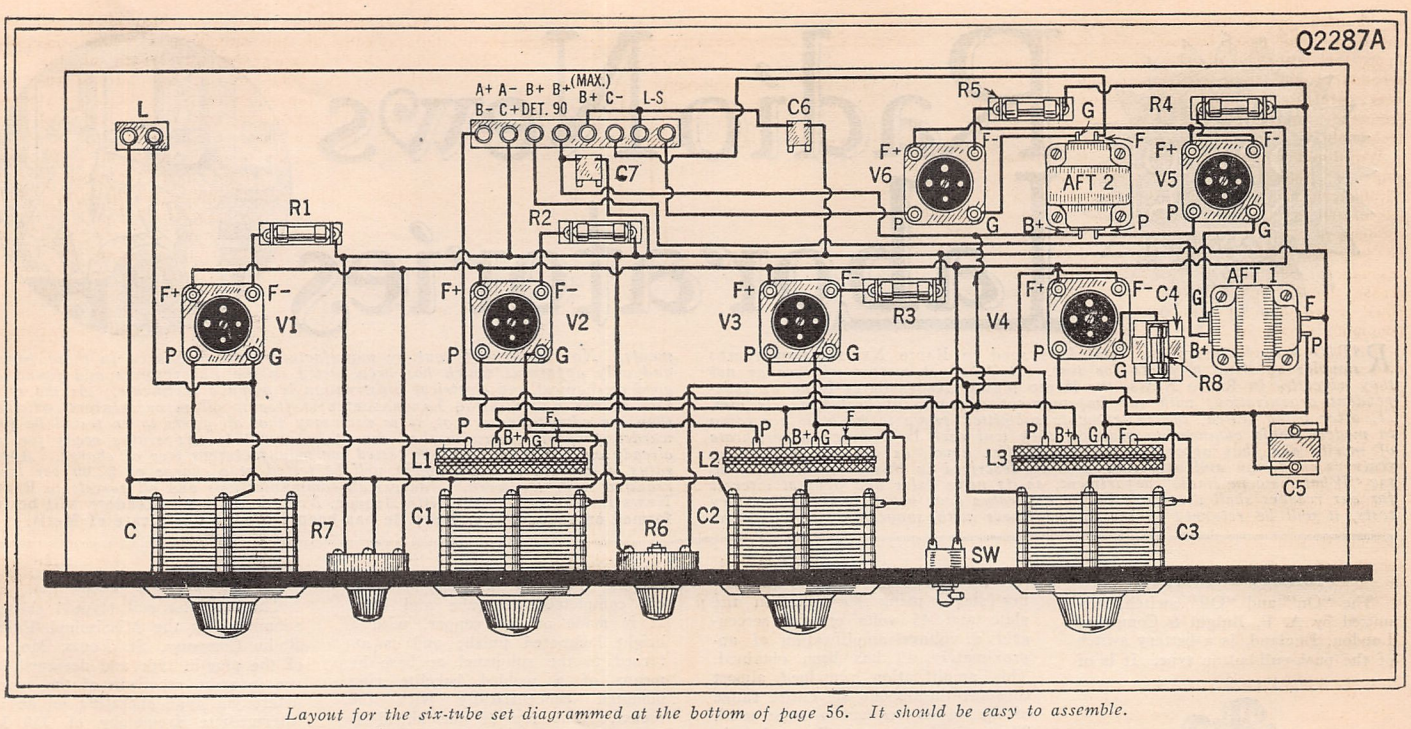
C6, 7, 1-mf. by-pass condensers;

R1, 2, 3, 4, 5, filament ballasts, ¼-ampere type;

R6, 20-ohm rheostat;



This six-tube set contains the essential features of the most popular commercial sets, it is easy to build and to operate; it is sufficiently sensitive and highly selective, without shielding, when not too close to a transmitter; and with a suitable power tube, will give ample volume for a large room. It is therefore recommended for construction and use in schools. It does not require an outside aerial.



Layout for the six-tube set diagrammed at the bottom of page 56. It should be easy to assemble.

R7, 400-ohm potentiometer;
R8, 2-megohm grid leak;
AFT1, 2, audio-frequency transformers;
SW, filament switch;
V1 to V5, 201A-type tubes;
V6, 201A-type tube (or 112A- or 171A-type; see below);
Six sockets, panel, baseboard (see below), eight or ten binding posts and strips, wire, etc.

Assembly

The apparatus should be laid out on a sub-panel slightly shorter than the panel, and should be placed in the respective positions shown in the pictorial diagram. A panel about 7x24 inches should be employed, and a baseboard about 23x8 inches. When the parts have all been mounted on the panel and baseboard, the set should be wired. This should be done following either the pictorial or the schematic diagram, checking off each lead as connected, and all the wires should be run as directly as possible, especially the grid and plate leads. The connections should be soldered carefully, either to soldering lugs or directly to the wire terminals.

If a power tube is employed in the set, the "B+ Max" and "C—" terminals should be connected to the correct "B" and "C" voltages on the batteries or plate supply, the voltages depending on the type of tube employed. If a power tube is not used in the last stage, the "B+Max" lead shown should be connected to "B+90", and the "C—" terminal should be connected to the negative terminal of a 4½-volt "C" battery.

When the set has been completed and the connections carefully checked, it may be tested for short circuits by connecting the "A" battery, one terminal to the "B—" and the other to the "B+" terminals in turn, with the tubes in the set. If the tubes light when contact is made in this manner, the wiring must be corrected. If it proves safe, connect the batteries in the proper manner, and proceed to operation.

It should be found that the four condensers give almost exactly the same reading when tuning in a station—that is, if the loop used is of the correct design for the condenser used with it. If it is so desired, the other three condensers may be ganged together for simplicity of control. This, of course, would necessitate changing the layout to correspond with the mechanical coupling arrangement used, but the tuning will be much simpler, and very satisfactory results may be obtained. It is not advisable to attempt to operate the loop-tuning condenser C from the same dial, however.

The potentiometer R7 should be turned until no whistles can be heard when the dials are rotated; the rheostat R6 should be turned up until normal brilliancy is obtained on the detector tube.

A 25-CYCLE "B" POWER UNIT

(2288). Mr. J. B. Roubidoux, Montreal, Canada, writes:

(Q.) "I would like to obtain constructional details for building a "B" power unit for use with 25-cycle current. I have noticed quite a few articles on the construction of power units of this type in Radio News, but they are all designed for 60-cycle current and naturally they are not suited for 25-cycle supply. I would also like to obtain the constructional details for making the transformer and choke coils to be used in this unit; since it is not very easy to obtain this apparatus designed for 25-cycle current."

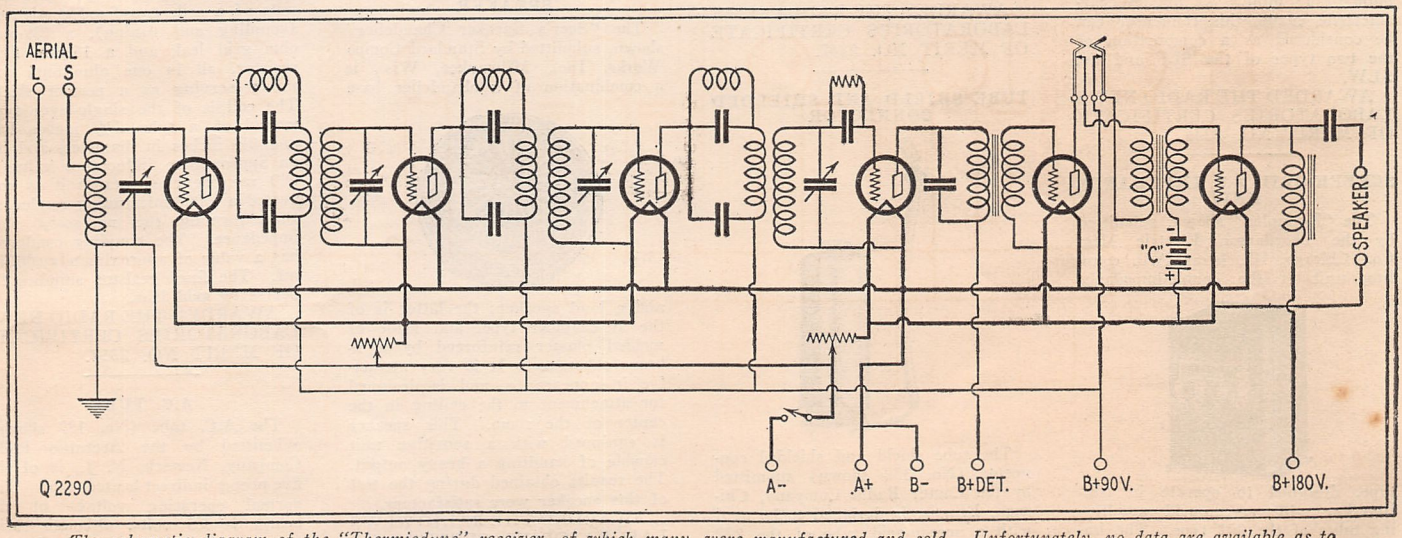
(A.) We have received a number of letters from our Canadian readers requesting constructional details for building 25-cycle power-supply units. For this reason, we are including data for constructing both the unit and the transformer and chokes to be employed in it. The diagram of the power unit will be found in Fig. Q. 2288A. As will be noticed, the unit has been designed to employ an 85-milliampere tube and is provided with two variable voltage output taps. This will permit the use of this unit with any type of receiver. Because of the lower frequency of this current, larger chokes and condensers are required than with 60-cycle A.C.

In Fig. Q. 2288B will be found the constructional details for the core of the power transformer. This core should be built up of silicon steel .014-inch thick. The "L" shaped laminations should be cut to shape, with either a hack-saw or a cold chisel, and the edges should be filed down so that no sharp points will remain. A sufficient number of laminations should be cut to make a pile 1⅞ inches high for each side of the core. After each lamination has been cut and its edges smoothed it should be shellacked carefully with a thin coat of white shellac. This is for the purpose of insulating the laminations in order to keep the eddy currents and heating effects in the core at a minimum.

Winding the Coils

The primary winding is placed over one of the

(*Continued on page 93*)



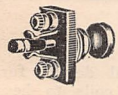
The schematic diagram of the "Thermiodyne" receiver, of which many were manufactured and sold. Unfortunately, no data are available as to the coils, or the value of the other parts used in this set.

Radio News Laboratories

RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES *samples of their products for test. It does not matter whether or not they advertise in* RADIO NEWS, *the* RADIO NEWS LABORATORIES *being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit; and that apparatus which embodies novel, as well as meritorious features in design and operation, will be described in this department, or in the "What New in Radio" department, as its news value and general interest for our readers shall deserve. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published in these pages, and only apparatus which has been tested in the Laboratories and found of good mechanical and electrical construction is given a certificate. As the service of the* RADIO NEWS LABORATORIES *is free to all manufacturers, whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted. Apparatus ready for, or already on, the market will be tested for manufacturers free of charge. Apparatus in process of development will be tested at a charge of $2.00 per hour required to do the work. Address all communications and all parcels to* RADIO NEWS LABORATORIES, *230 Fifth Avenue, New York City.* **Readers will be informed on request if any article has been issued a Certificate of Merit.**

FILAMENT SWITCH

The "On" and "Off" switch, submitted by A. F. Bulgin & Company, London, England, is a battery switch of the push-pull-button type. It is of

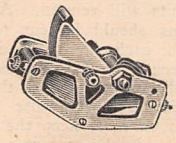


very neat appearance and faultless operation. No noises due to defective contacts are to be feared, as the contacts made by this switch are almost perfect.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2344.

VARIABLE CONDENSER

The "Minerva Logarithmic" condenser shown, submitted by W. Wohleber & Company, Vienna, Austria, is a very-well-built electrical instrument. Like most modern variable condensers, it is constructed almost entirely of metal and has a very small amount of insulating material. The stator and rotor are provided with spacing bars, securing rigidity and permanency of calibration. A

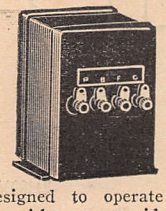


floating shaft makes possible gang mounting, and a pigtail insures noiseless connection between the rotor and the condenser frame. These 23-plate condensers have a maximum capacity of 483 mmf. and a minimum of 13 mmf. As for its characteristic curve, this condenser can be considered as a combination of the two types of the SLF and the SLW.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2345.

SCREEN-GRID A.F. IMPEDANCE UNIT

The "Z-coupler" shown, submitted by the Thordarson Electric Mfg. Co., Chicago, Ill., is an A.F. coupling unit of the double-impedance

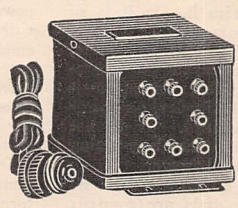


type, designed to operate in conjunction with screen-grid amplifying tubes of the 222 type. The impedance value of this unit is extremely high, and with one amplifying stage, using 90 volts on the plate and 45 volts on the screen-grid a voltage amplification of approximately 40 has been obtained. This amplification remained almost constant throughout the entire range of the audio frequencies most used. The unit is hermetically sealed in an iron shell with a black crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2346.

A.C. FILAMENT TRANSFORMER

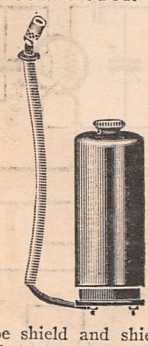
The transformer ("TCA No. 687" shown) submitted by the Transformer Corporation of America,



Chicago, Illinois, operates from the 110-volt 60-cycle, house-lighting line, and supplies the necessary filament power for the operation of a radio receiver employing four to six tubes of the 226 type, a 227-type detector, and one or two power tubes of the 171 type. At full load, the measured voltages have been found to be very close to their rated values. The 5-volt winding for the power tubes and the 2.25-volt winding for the detector are center-tapped. This transformer is well built, and is sealed in a sturdy iron casing, 3½ x 3½ x 4½ inches, of black crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2347.

TUBE SHIELD AND SHIELDED CONNECTOR



The tube shield and shielded connector (No. 322 shown) submitted by the Carter Radio Company, Chicago, Illinois, is designed to be used with a screen-grid tube of the 222 type. The shield is 5⅛ inches high and 2⅛ inches in diameter, and covers completely the tube and base. It is made of red copper, with a bright lacquered finish; and is attached to the sub-panel or base by means of a molded bakelite ring mounted concentrically with the socket. The top of the shield is provided with a removable cap, which makes it possible to attach the slotted cap of the shielded connector to the grid terminal at the top of the tube.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2348.

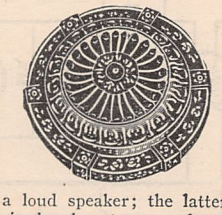
R.F. CHOKE COIL

The choke coil (type C-60 shown) submitted by Aero Products, Inc., Chicago, Illinois, has an approximate inductance value of 6 millihenries and a very low distributed capacity. It is wound in three grooves on a wooden spool 1 inch long and 1⅛-inch in diameter. The grooves are each approximately ¼-inch deep and ⅛-inch wide, spaced ¼-inch. The coil is housed in a neat bakelite shell, and can be mounted by making one hole.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2350.

SPEAKER

The "Seer's Speaker Chandelier" shown, submitted by Standard Compo Works, Inc., Milwaukee, Wis., is a combination of a chandelier base



and a loud speaker; the latter is of the air-chamber type, and made of molded plaster reinforced by a fibrous substance. It is very attractive in appearance, and is designed for attachment to the ceiling in the center of the room. This speaker is equipped with a sensitive unit capable of handling a heavy output. The results obtained during the test of this speaker were satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2354.

OSCILLATOR COIL

The oscillator coil (type 1 shown) submitted by the Mississippi Valley Radio Company, St. Louis, Mo., is of the plug-in type and designed for use in radio receivers of the superheterodyne type operating on an intermediate frequency of 350 kc. This coil is wound on a tube 1½ inches in diameter and 2⅛ inches high, and has two sections, of 37 turns each, spaced ⅛-inch. The inductance value of the two windings connected in series is 162 microhenries. A small rotor, 1⅛ inches in diameter and ¼-inch long, has approximately 10 turns, and acts as a coupler with the rest of the circuit.

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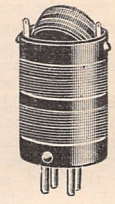
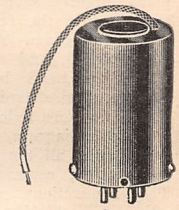


No. 2355



No. 2357

SHIELDED R.F. IMPEDANCE

The "Braxton King" R.F. impedance unit shown, submitted by the same manufacturer, is an interstage coupling element, operating in connection with vacuum tubes of the 222 type. It is intended to be used in the 350-kc. intermediate-frequency stages of radio receivers using the oscillator coil described under Certificate No. 2355. This impedance unit is of the plug-in type and consists of a coil, two fixed condensers (coupling and tuning), a 2½-megohm grid leak and a 15-ohm fixed resistor, all in one aluminum container serving as a perfect shield. The coil is of the single-layer type, wound on a tube 2⅛ inches long and 2½ inches in diameter, and has an approximate inductance value of 600 microhenries; across it is connected a .0003-mf. tuning condenser, thus forming the necessary plate impedance. The coupling condenser has a value of approximately .00012-mf. The fixed resistor supplies the necessary grid bias.

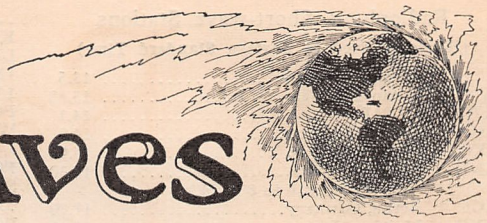
AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2357.

A.C. TUBE

The A.C. tube (No. 127 shown) submitted by the Arcturus Radio Company, Newark, N. J., is of the five-prong indirect-heated type. The normal operating voltage of the heater is 2.5 volts, although satisfactory results were obtained over

(*Continued on page 92*)

On the Short Waves



OLD-WORLD BROADCASTERS

Mr. E. T. Somerset, of Sussex, England, contributes the following information in regard to short-wave stations heard by him:

"I am appending a list of short-wave stations that one can definitely listen to with a reasonable degree of success, all of which I have heard more than once myself: 8GC, Paris on 61 meters; RFN, Russia, on 60 meters; AGJ, Nauen, Germany, on 56.70 meters; SAJ, Karlsborg, Sweden, on 50 meters; 1AX, Rome, Italy, on 45 meters; Vienna, Austria, on 44.40 meters; Radio-Lyon, France, on 39.50 meters; AFK, Zeesen, Germany, on 37.65 meters; JHBB, Iberakiken, Japan, on 37.50 meters; Radio-Vitus, Paris, on 37 meters; 6AG, Perth, West Australia, on 32.90 meters; 9XD, Zurich, Switzerland, 32 meters; 3LO, Melbourne, 32.60 meters; ANE, Bandoeng (Java) Radio, 31.93 meters; PCJJ, Hilversum, Holland, 30.20 meters; LGN, Bergen, Norway, 30 meters; 2ME, Sydney, Australia, 28.50 meters; 5SW, Chelmsford, England, 24 meters; PCLL, Kootwijk, Holland, 18 meters and ANH, Malabar (Bandoeng) 17 meters.

"The following information may aid in tuning-in short-wave stations. Station AFK, Doeberitz, Germany, on a wavelength of 37.65 and 67.65 meters announces the following in German: 'Kurzwellensender Anna Friedrich Karl.' The time to search for this transmitter is between 6 A. M. and 2 P. M., E.S.T.

"Station 7RL at Copenhagen is owned by a Danish newspaper and operates on a wavelength of 42.12 meters. ANE, Bandoeng radio service, Java, is operating on a wavelength of 15.93 meters and can be heard between 9:40 and 11:40 P. M., E.S.T. The Eiffel Tower, Paris, operates on a wavelength of 31.10 meters and can be heard after 4 P. M., E.S.T."

AUSTRALIAN 32-METER PROGRAMS

Arrangements have recently been completed to broadcast a weekly program over station 3LO, Melbourne, Australia, on a wavelength of 32 meters. By taking this step the Australian station hopes to establish a short-wave service for listeners, not only in the British Empire, but everywhere. Reports on reception have already been received by 3LO from listeners in various parts of the United States, Great Britain, Alaska, Japan, China, India, Java and the Pacific Isles. All reports comment favorably on the short-wave service, it is said; and it is hoped that each weekly effort will result, not only in improved transmission, but in better reception brought about by these continued short-wave experiments.

OFFICIAL DUTCH TRANSMITTER

A bulletin received from the press department of the Netherlands Post and Telegraph Service, The Hague, Holland, states that PCLL, at Kootwijk, has recently started programs of general interest on Holland and its possessions. The co-operation of the amateurs is requested in listening for this news, which is being sent out in four languages, Dutch, English, French and German. The transmission takes place every Wednesday between 7 and 8 P. M. (E.S.T.), on a wavelength of 18.1 meters. This station is equipped with a beam transmitter, which, it is stated, reduces the angle of radiation to 30 degrees in its vicinity. A number of our readers have reported receiving speech and music from it.

RELAY BROADCAST LICENSES

There are now about 35 radio stations in the United States which are classified as "relay broadcast stations," by reason of the fact that they transmit on short-wave channels for the purpose of pickup and rebroadcasting at some other point, often in a distant part of the world. Most of the relay broadcasting is done by stations regularly transmitting programs on wavelengths within the broadcast band.

The numerous applications received by the Federal Radio Commission from additional stations seeking to broadcast simultaneously on short waves, in addition to their regularly-assigned waves, has led the Commission to schedule this as one of the problems of future policy which will come in for serious consideration in the near future.

So far, relay broadcast licenses have been issued where the sending of programs to foreign countries or communication with a "central" or "master" station for purpose of rebroadcasting has been desired.

Station 2XAL's Schedule

THE 30.91-meter transmitter operated by RADIO NEWS broadcasts the same program as that simultaneously given by WRNY on 326 meters; its hours, in Eastern Standard Time (add five hours for Greenwich Time) are daily from 10:00 a. m. until noon, and also the following afternoon hours:

Mondays, 1:00 to 6:00; Tuesdays, 6:00 to 11:00; Wednesdays, 1:00 to 8:00; Fridays, 1:00 to 10:00; Saturdays, 6:00 to 9:00; Sundays, 12:30 to 6:00.

RADIO NEWS will be very glad to receive and acknowledge all reports of the reception of this station, and especially the usual information as to reception conditions. In addition to those from North American listeners, letters and cards have already been received from amateurs and short-wave set owners in British Guiana, Brazil, England, France, Holland, Portugal, Germany, Austria, Czechoslovakia, Hungary, Morocco, India, Australia and New Zealand, and from operators of ships at sea. "I used two tubes on you," writes Leo Nunn, of Kyogle, New South Wales, Australia, "and could have got you on speaker on three, only I did not want to wake up the family." Other acknowledgments have been made elsewhere in these columns and by mail.

While, owing to the "skip-distance" effect, listeners-in within a few hundred miles of a short-wave transmitter cannot depend upon tuning it in regularly, occasionally it is possible to do so; and we shall be equally gratified to have reports of reception of this station from nearby, as well as from around the world. Address

EDITOR, RADIO NEWS,
230 Fifth Ave., New York City, U. S. A.

New Zealand listeners report hearing 4XD, the short-wave transmitter of WSM, Nashville, Tennessee, on 31.44 meters.

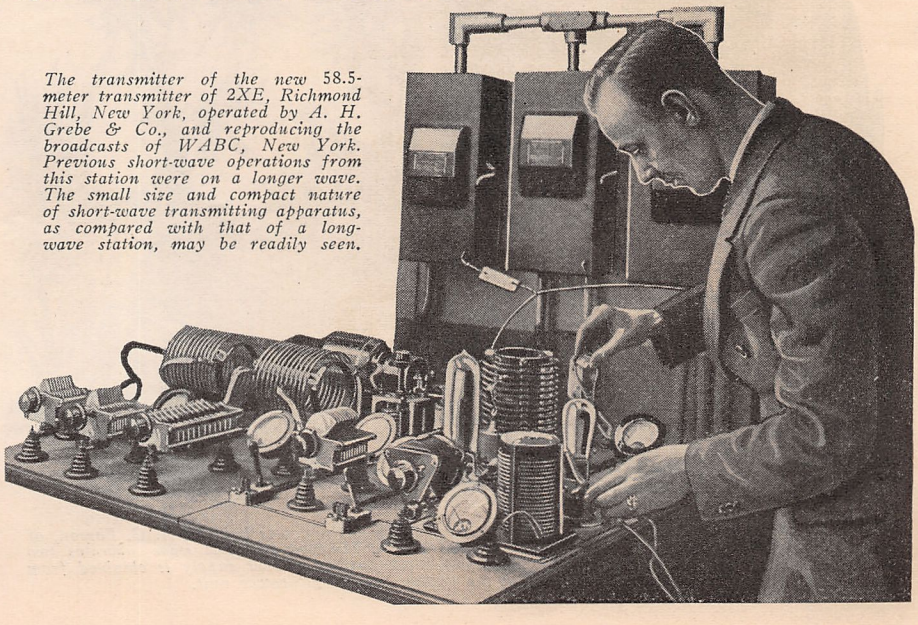
South African listeners have been puzzled recently by a station heard calling "Hello, Japoni," around 32.82 meters. Letters to the *S. A. Wireless Weekly* suggest that it may be Peking, or the Belgian Congo. However, considerable strength of signal was reported at Capetown. French conversation on radio matters was heard from this station.

THOSE RUSSIAN STATIONS

Marvin H. Thoreau, of Vancouver, B. C., has been unusually successful in logging foreign short-wave stations. He tells of his experiences as follows: "In a recent issue of RADIO NEWS, a reader refers to a short-wave broadcast station apparently as RSN. This is really RFM, Khabarovsk, Siberia, not far inland from Vladivostok. RFM is now operating on approximately 70 meters and can be easily tuned-in at 2 A. M., (P.S.T.), any morning except Wednesday. Sometimes they can be found earlier. Their program usually consists of news items, with musical numbers now and then. On a recent Sunday evening they gave a special all-musical program shortly after midnight. RFM is apparently using very high power and must be crystal-controlled. Signal strength is usually excellent. 5SW, of Chelmsford, England, comes in almost daily from noon to 4 P. M., (P.S.T.), sometimes with loud-speaker strength. 2FC of Sydney, Australia, on 28.5 meters, can often be heard about 2 A. M. I have also heard Malabar, Java; Eindhoven, Holland, and JHBB, Japan, the latter on approximately 37 meters. My receiving set uses the usual plug-in coils and is an autodyne detector followed by two stages of intermediate frequency, second detector and two stages of audio frequency; six tubes in all and practically single-control."

Another reader, Dr. Roy M. Byram of Kangkei, Korea, contributes the following information about the much-discussed Russian short-wave broadcast station; "Our best station is RSN at Khabarovsk, Siberia. It comes in with volume too loud for pleasure on my RADIO NEWS set. As yet, I do not have the wavelength. I should like to tell you, though late, that I heard very clearly the broadcasting of the Stanford-Pittsburgh football games played in the Rose Bowl, Pasadena, California, on January 2. The program came over the WGY short-wave transmitter. Since January reception has not been so clear."

Charles Walton of Fresno, California, supplies the following with regard to the Russian broadcast stations being heard by our readers: "In reference to your article in the April edition of RADIO NEWS, page 1191, I beg to inform you that Mr. Blackington of Wrangell, Alaska, is right as to the Khabarovsk station operating on a wavelength of 56 meters. Also your Japanese friend, N. Miyake, is also correct; only that RFN is located at Moscow and is evidently a still more powerful station than RSN, as it comes in with much more volume and the carrier-wave has greater strength. I have been hearing both of these stations for some time as late as 6.30 A. M., (P.S.T.), but they come in best around 4 o'clock. We on the coast figure that the wavelength of RFN is nearer 70 meters."



The transmitter of the new 58.5-meter transmitter of 2XE, Richmond Hill, New York, operated by A. H. Grebe & Co., and reproducing the broadcasts of WABC, New York. Previous short-wave operations from this station were on a longer wave. The small size and compact nature of short-wave transmitting apparatus, as compared with that of a long-wave station, may be readily seen.

Radiophone Short-wave Stations

(Hours reduced to Eastern Standard Time)

....	Nauen, Germany	13.5
WNJ	Ocean Township, N. J.	13.88
KWE-KEWE	Bolinas, Calif.	14.1
AGA	Berlin, Germany	14.9
2XG	Rocky Point, N. Y.	16.02
ANH	Bandoeng, Java	17.30
	(Daily, 6 to 8 P. M.)	
AGC	Berlin, Germany	17.20
ANE	Malabar, Java	17.40
POZ	Nauen, Germany	18.1
	(Daily, after 9 P. M.)	
PCLL	Kootwijk, Holland	18.70
	(Mon., Wed. & Fri., 7 to 8 P. M.)	
JIPP	Tokio, Japan	20.00
	(Daily, 4 P. M. to finish)	
JKZB	Tokio, Japan	20.00
	(Alternates with JIPP)	
PCTT	Kootwijk, Holland	21.00
2XAD	Schenectady, N. Y.	21.96
2XE	Richmond Hill, N. Y.	22.10
WAJ-WEAJ	Rocky Point, N. Y.	22.48
	(Transatlantic beam station)	
....	Fort Wayne, Ind.	22.80
2XAA	Houlton, Maine	23.00
5SW	Chelmsford, England	24.30
....	Berlin, Germany	26.50
KDKA	Pittsburgh, Pa.	27.00
PCPP	Kootwijk, Holland	27.00
2ME	Sydney, Australia	28.50
RFN	Moscow, Russia	29.00
	(Daily 3 to 5 A. M.)	
PCJJ	Hilversum, Holland	30.20
2XAL	New York, N. Y.	30.91
RFM	Khabarovsk, Siberia	30.00
	(Daily 5 to 7 A. M.)	
....	Helsingfors, Finland	31.50
EH9OC	Berne, Switzerland	32.00
	(Mon., Wed. & Sat. 3 to 5 P. M.)	
2FC	Sydney, Australia	32.00
CF	Drummondville, Canada	32.00
EH9XD	Zurich, Switzerland	32.00
3LO	Melbourne	32.00
JB	Johannesburg, S. Africa	32.00
3LO	Melbourne, Australia	32.60
2NM	Caterham, England	31.50
2XAF	Schenectady, N. Y.	32.77
	(Tues. & Sat., 6 to 10.30 P. M.)	
7MK	Copenhagen, Denmark	32.90
	(Tues. & Fri., 4 to 6 A. M.)	
6AG	Perth, West Australia	32.90
	(8.30 A. M. on)	
6XAR	San Francisco, Calif.	33.00
....	Malabar, Java	33.00
XDA	Mexico City, Mexico	34.00
PCRR	Kootwijk, Holland	37.00
RA19	Tomsk, Siberia	37.00
....	Paris, France	37.00
JHBB	Ibarakiken, Japan	37.50
PCUU	The Hague, Holland	37.50
JFAB	Taipeh, Formosa, Japan	39.50
....	Lyons, France	40.00
6XBR	Los Angeles, Calif.	40.00
	(Irregular)	
1AA	Iwatsuki, Japan	40.00
SMHA	Stockholm, Sweden	41.00
....	Stuttgart, Germany	42.00
KDKA	Pittsburgh, Pa.	42.95
LA	Langenberg, Germany	43.90
1MI	Milan, Italy	45.00
1AX	Rome, Italy	45.00
PCLL	Kootwijk, Holland	45.00
WND	Ocean Township, N. J.	46.48
	(Transatlantic phone)	
PCMM	The Hague, Holland	46.50
SAJ	Karlsborg, Sweden	47.00
....	Konigswusterhausen, Germany	52.00
WLW	Cincinnati, Ohio	52.02
3AR	Melbourne, Australia	55.00
ANF	Malabar, Java	56.00
AGJ	Nauen, Germany	56.70
KFWO	Catalina Island	57.03
2XE	Richmond Hill, New York	58.50
3XQ	Bound Brook, N. J.	60.00
9XU	Council Bluffs, Iowa	61.06
KDKA	East Pittsburgh, Pa.	62.50
2XBA	Newark, N. J.	65.18
6XAI	Inglewood, Calif.	66.04
RFN	Khabarovsk, Siberia	70.00
	(Mon., Wed., Sat., 4 a m. on)	
RDW	Moscow, Russia	83.00
7XAB	Spokane, Wash.	105.9
2XE	Richmond Hill, N. Y.	106.00
6XBR	Los Angeles, Calif.	106.00
	(Portable)	
1XY	Tilton, New Hampshire	109.00

BECAUSE of the experimental nature of almost all radiophone work, and especially of all short-wave broadcasting, wavelengths, power, hours, and everything else connected with this list are subject to change without notice. We especially invite all short-wave broadcasters throughout the world to send us the latest data on their transmissions; and all hearers who know of changes or additions to this list to advise us at once. By this means, short-wave listening can be facilitated for all fans, who will know better what to fish for.—EDITOR.

Letters From Short-Wave Set Owners

AN 18-METER STATION?

A. L. Foss of Central Aguirre, Porto Rico, desires information on a station operating on 18 meters and writes in part as follows: "Could you tell me what station would be broadcasting at about 5.30 P. M., (E.S.T.), on about 18 meters? I have heard this station twice, distinctly, broadcasting music but no announcements. I also heard a station broadcasting in Dutch at about the same time on a wave of about 33 meters."

G. R. Sittler of Brooklyn, N. Y., has constructed the short-wave receiver described in the December, 1926, issue of RADIO NEWS and reports hearing a number of American and European short-wave broadcast stations. He has found that very loose coupling to the antenna circuit gives best results and uses a small fixed condenser in series with the aerial. This condenser consists of two metal plates one-half inch square, and one-quarter of an inch apart.

H. Charrington of Hongkong, China, writes as follows: "I have just completed a short-wave receiver something like the one described in RADIO NEWS. Last night, or rather this morning, I tuned in 2XAF at 3:40 A. M., 2LO, London, at 4 A. M., and PCJJ, Hilversum, Holland at 2:15 A. M. I was quite surprised at the quality of the music which I enjoyed very much."

"In answer to your request for short-wave data," writes Alvin Carlson of Gladstone, Mich.: "I wish to state that 5SW, Chelmsford, England is now operating on a regular schedule from 1 P. M. to 6 P. M., (C.S.T.), which is 7 P. M. to 12 P. M. London time, daily except Sundays. They come in with very good volume but, for the last three days, there has been considerable high-speed fading of their signals. I have heard them since March 21. My receiver uses two tubes in the Reinartz circuit. Mr. Beese was certainly right when he said that announcements are very infrequent at 5SW. Another thing about this station is that they sign off at midnight, London time, by striking a gong twelve times and close down without any announcement of call letters."

COIL SUGGESTIONS

A number of useful constructional hints are contained in a letter from A. E. Coatsworth of Thunderbolt, Ga., who writes as follows: "In answer to your request in a recent issue of RADIO NEWS for some short-wave data, I have the following to offer. I am a radio operator running between the States and Germany and have a chance to study the effects of different connections and coils. I have tried all types of coils and have found that, by winding them with No. 12 enameled wire (such as is used for aerials), I get greater signal strength and a more rigid coil. I wind the coil on a regular No. 6 dry cell and then remove same. The coil is space-wound and, for separators, I use beads which will just slip over the wire. The beads are staggered to decrease the spacing between the turns and are held in place by thread. This makes a rigid coil and has nothing to cause an increase in capacity.

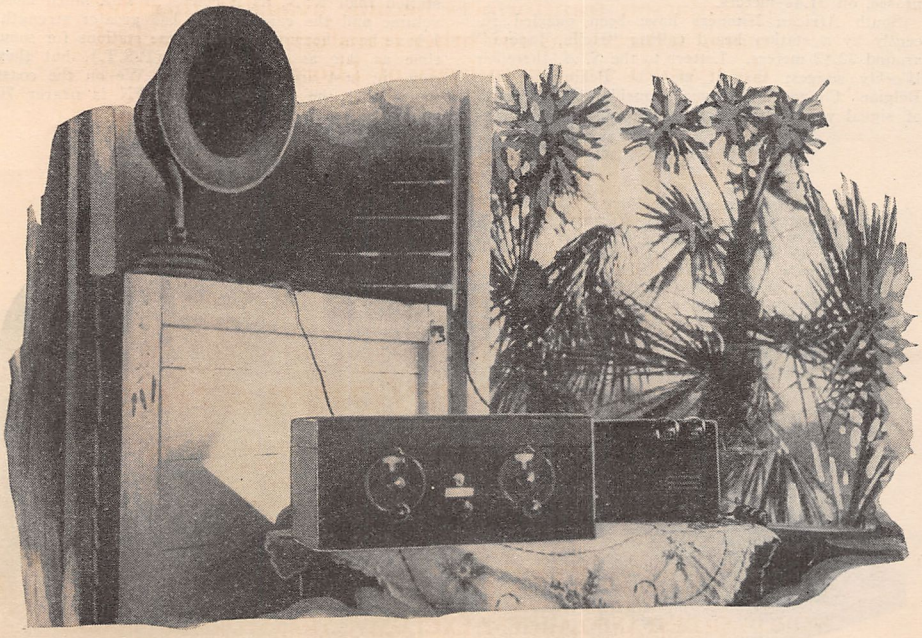
"For the tickler winding I use No. 26 D.C.C. wire and bunch the winding to make it as compact as possible. It is then placed inside the heavy coil between the first and second turns, holding it in place with thread. I do not find this too close, and the set goes in and out of oscillation with a faint hiss as it is supposed to do. The radio-frequency choke coil is another important part of the set and, although quite a few writers say that a number of turns of fine wire will answer, I find the best coil to be a long slim one. I use a common cedar pencil with the lead removed. The winding is put on the pencil after it is glued back together. I find that 135 turns of number 30 D.C.C. wire will cover the short waves and not leave any "holes" in the tuning which cannot be changed with the antenna tuning condenser. A very small variable condenser is used in series with the aerial as it is very large. If the set is found to give trouble when going in and out of oscillation, another turn should be added to the tickler coil, which will remedy the trouble. Another important point is to put the tickler on the end of the coil which goes to the "A" battery and ground connection.

"I can get WGY or KDKA, when lying at the dock at Hamburg, Germany, on the loud speaker, using but three tubes and 45 volts on the plate. KDKA fades, as seems to be its custom, but WGY is pretty consistent."

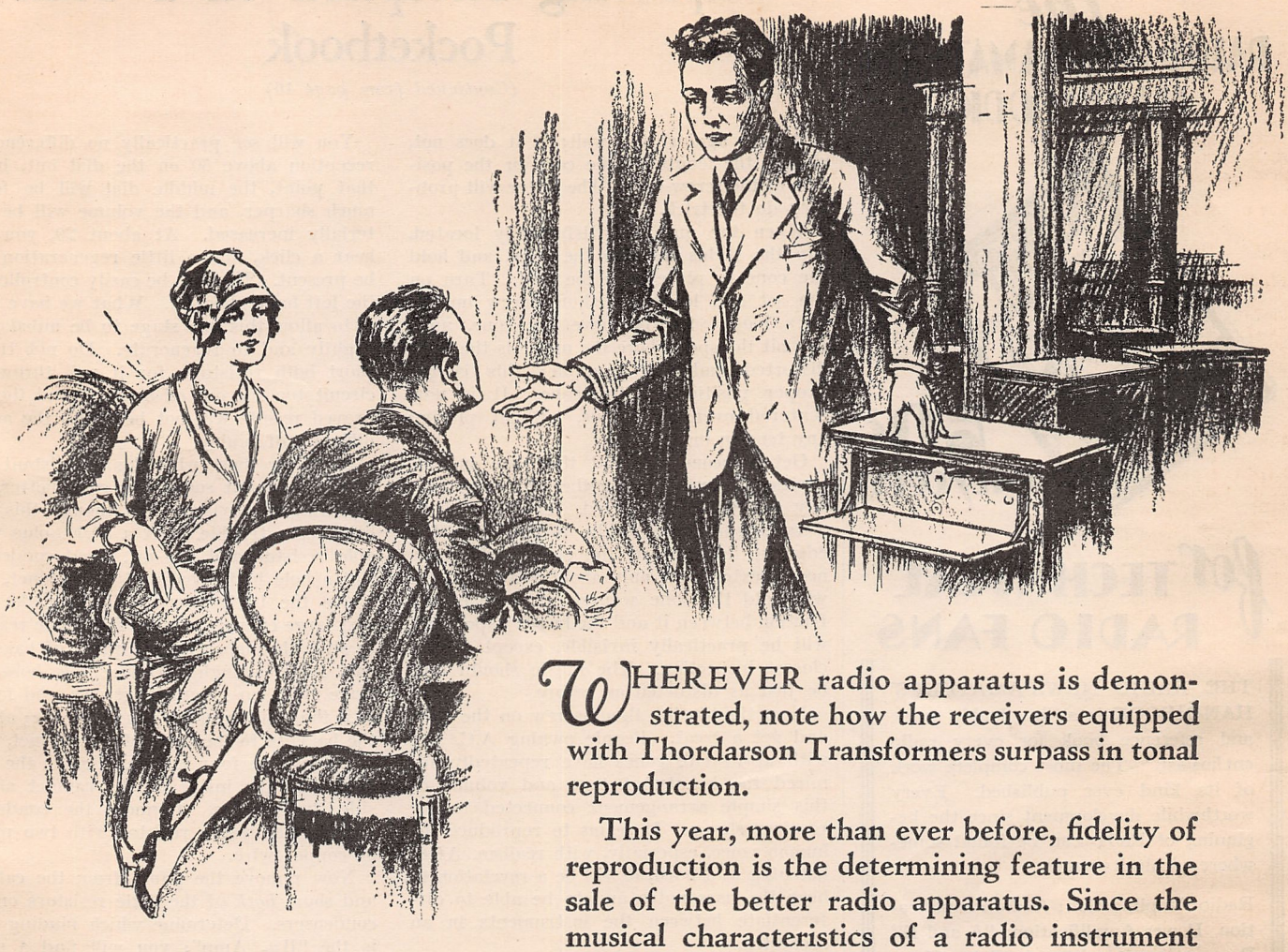
A JUNK SET

G. W. Robinson of Buffalo, N. Y., contributes the following: "After reading your article on the short-wave receiving set I threw a set together, using old discarded and '5 & 10' parts. It worked so well that I have never changed it. While writing this I am listening to 5SW, England, broadcasting dance music on 24 meters. I consistently pick up this station every evening between 5:30 and 7 P. M., (E.S.T.), except Saturday and Sunday, sometimes with enough volume for the loud speaker. You state in your April issue that PCJJ has moved from Eindhoven and is now listed as being at Hilversum. This I believe is in error as I have received this station a number of times and the announcement is 'Philips Laboratories, Eindhoven.' *(The transmitter has been moved.* —EDITOR.) This station comes in a couple of points below WGY, I should judge on about 30 meters. They do not seem to have a regular schedule, as I have heard them on Tuesday and Thursday evenings between 7 and 9 o'clock and then not heard them again for some time. Recently I

(Continued on page 91)



This RADIO NEWS *short-wave receiver, shown in a tropical setting, was built by A. C. Larson, of the naval station at Guantanamo Bay, Cuba, and with a 210-type push-pull stage, operates two loud speakers with tremendous volume. Not only that, but its current supply is obtained from an automobile battery in the garage and a "B" power unit.*



WHEREVER radio apparatus is demonstrated, note how the receivers equipped with Thordarson Transformers surpass in tonal reproduction.

This year, more than ever before, fidelity of reproduction is the determining feature in the sale of the better radio apparatus. Since the musical characteristics of a radio instrument depend to such a great extent on a wise selection of the audio and power supply transformers, it is significant that so many leading manufacturers have turned to Thordarson as the logical transformer source.

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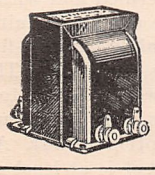
RADIODYNE
Mohawk
Buckingham
MURDOCK
WALBERT
OZARKA
ARGUS
AUDIOLA
ERLA
and many others



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Improving Reception on a Thin Pocketbook

(*Continued from page* 46)

rests flat against the wall; if it does not, change the length of the cord or the position of the screw-eyes. The latter will probably do the trick.

When the unit is satisfactorily located, slip the stylus through the apex, and hold the cone in place over the unit. Turn on the set and leave the thumbscrew on the apex loose. Slowly move the cone, until you hit the spot where the music is the most distorted and least audible; this is the proper position of the cone. It is now centered over the stylus, without placing any tension on it.

Get someone to hold the cone in this position for you, letting the set run so that any slip will be detected. Carefully drive a talking-machine needle through the top edge of the cone at the center. Let this needle extend out only about 1/16-inch. It will hold the cone securely because of the friction between it and the heavy paper, and will be practically invisible, except on the closest inspection. The music should now be just as distorted as before.

Now tighten the thumbscrew on the apex and get a treat. People owning A.C. sets with up-to-date cones have repeatedly admired the beauty of tone and volume of this simple arrangement connected to the receiver shown. It seems to reproduce the human voice, especially, with realism. After listening to a horn, it will be a revelation to hear the bass notes and to be able to differentiate between the instruments in an orchestra.

No doubt the use of an output device has now occurred to you. They do improve tone somewhat, but they are not necessary with a unit such as this. Although the writer has tried output devices on his set, he does not regularly use one; but would recommend a good transformer rather than a choke-and-condenser filter.

CHANGES IN THE SET

Now that the audio end is fixed up, you may be interested in improving the selectivity and distance-getting ability of your receiver. After trying wave traps, resistance-coupled radio frequency, choke-coil radio frequency, regenerative detector, etc., I eliminated everything but two simple changes as impractical for the average broadcast listener. I will describe the simplest first.

Remove the panel from the cabinet and lay it on a table, dials down. As you now look down at it, you will notice little flat (or round) strips, wound with very fine wire, on the backs of two of the variable condensers. These strips are near the bottoms of the condensers, and at the right of the coils. These are grid resistors for the purpose of stabilizing the R.F. tubes. Take a short piece of copper wire and shunt it across the resistor on the *middle* condenser; in other words, just short this resistance out of the circuit. Do not disturb the resistor on the first condenser. Solder the wire to both sides of the resistor to make a good connection. Put the panel back in the cabinet, hook up the wires to the binding posts, and the job is done. It takes about ten minutes.

You will see practically no difference in reception above 50 on the dial but, below that point, the middle dial will be found much sharper, and the volume will be materially increased. At about 20, you will hear a click, and a little regeneration will be present. This can be easily controlled by the left-hand rheostat. What we have done is to allow this one stage to be unbalanced slightly and to regenerate. Do not try to short both resistors, for it will throw the circuit too far out of balance, and the improved results will not be worth the added difficulty of tuning.

Now, for those who like the distant stations, and want something even better, the following is advised, even though this is a little more trouble. Get a 50,000-ohm variable resistor and a 1-mf. fixed condenser. Cut a hole in the back of the cabinet, just above the battery connections; make this just large enough to allow the whole resistor to slide through. Take a piece of bakelite, just large enough to cover this hole and leave room for mounting screws, and fasten to it the resistor in the usual manner; attach the bakelite to the back of the cabinet, over the hole, with four screws. Fasten the condenser to the inside of the cabinet alongside the resistor. Connect the condenser directly across the resistor with two pieces of copper wire.

Now remove the panel from the cabinet and short *both* of the little resistors on the condensers. Determine which binding post is the "B+ Amp"; you will find a short piece of wire connecting this post with one of the speaker posts. A green wire will be attached to either of these, and a brown wire which goes back to near the panel and then down to the R.F. tubes. With a soldering iron, detach the brown wire from the post to which it is connected. Get two pieces of flexible insulated wire about eight inches long. Solder the end of one of these to the brown wire and tape the joint securely. Solder the end of the other wire to the post from which you removed the brown wire. Replace the panel in the cabinet and connect the two free wires to the two posts on the variable resistor.

You now have another control, but it is necessary only to use it on distant stations. It is really an oscillation control; by getting the circuit near the point of regeneration, great amplification is obtained. For locals, tune in a local station of a low wavelength and adjust the resistor until the squeal when tuning is just stopped. Leave it at this setting for all locals.

I have been using this improved set as described for a year and a half, and it most certainly is more than twenty dollars better than the original. As for distance, I receive the West coast here in Jersey with fair regularity. This has been repeatedly verified and witnessed, and all this was on the cone with fairly good volume.

My aerial is seventy-five feet long, and twenty-five feet high. The purpose of the article, however, is not to hatch some more DX hounds. My ambition is to improve the radio reception of Mr. Average Man, and I hope that it is at least a step in the right direction.

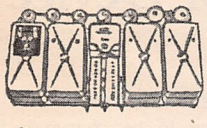
Aluminum Contributes to Radio

—*Lightness, Beauty, Finer Results*

MANUFACTURERS of the finest sets are using Aluminum in constantly increasing quantities. Their tests have demonstrated that Aluminum is the *one* metal that most efficiently meets the widely differing conditions encountered in radio design.

Its lightness; its permanent beauty; the fact that it does not rust or corrode; its high electrical conductivity; its efficient shielding quality; its "workability"—all are advantages that combine to make Aluminum the ideal metal for radio.

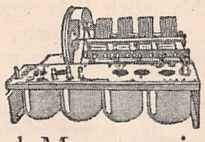
IN many of the most advanced receiving sets Aluminum Shields are used to achieve better



tone quality, greater selectivity, closer tuning—in short, finer reception.

Aluminum shielding reduces interference. It eliminates electrostatic and electro-magnetic interaction between various stages of radio-frequency amplification. It eliminates modulation of radio frequency stages by feed-back from audio-frequency amplifier. It makes possible more compact design.

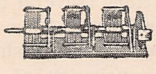
Aluminum performs these functions efficiently and adds



less to the weight of the set than any substitute metal. Moreover, it is easily worked into special shield shapes—cans, boxes or casings. Thus it presents few limitations of size and shape.

It allows the engineer great freedom to design his shielding to meet, ideally, the various requirements of his set.

ALUMINUM is widely used for variable condenser blades. Aluminum Company of America produces special sheet Aluminum for this purpose that is accurate and uniform beyond anything hitherto attained. Gauge tolerance in thickness is



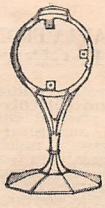
±.001 inch and the *total* variation within one sheet is limited to .0005 inch.

Aluminum Company of America also makes finished condenser blades from this highly accurate and uniform sheet.

THE leading manufacturers of foil and paper fixed condensers now use Aluminum foil because of its high electrical conductivity and its great covering area (a pound of Aluminum foil .0003 inch thick covers 34,000 square inches). Terminals can readily be soldered to Alu-

minum foil condensers by a process recently developed by Aluminum Company of America.

ALUMAC Die Castings of Alcoa Aluminum combine lightness, strength, accuracy and high conductivity. They have equal strength with *less than half the weight* of other casting materials. They are used with complete success for loud speaker frames and bases, condensers and condenser frames, drum dials, chasses—and even for cabinets.



There is a fund of information on the use of Aluminum in radio, and on radio in general, in the new edition of "Aluminum for Radio." Your copy of this interesting book will be mailed on request.

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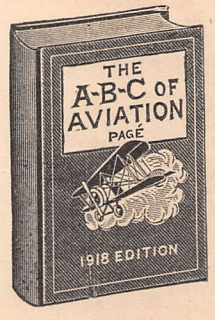

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A Sturdy and Dependable "B" Power Unit

(*Continued from page 43*)

adjustment of the air gaps of the choke coils is the third method of eliminating hum. To adjust these gaps, loosen the four bolts of each choke coil and place strips of paper in each gap of the core (there are two gaps in each core) to serve as separators; then tighten the bolts. By experiment it is possible to determine the amount of paper required.

Before concluding this article it is necessary to include one warning: namely, if the plate of the rectifier tube becomes red-hot, there is something wrong with the power unit and the power should be turned off immediately. Also, the power should not be turned on again until the defective piece of apparatus has been discovered. Usually it will be found in such a case that one of the filter condensers requires replacement.

The following is a complete list of the apparatus required for the construction of the power unit:

One power transformer; 110-118-125-volt primary, two 8-volt 2½-ampere secondary windings and one 525-volt 60-milliampere secondary winding, T1;
Three iron-core choke coils; 60-milliampere, 50-henry, 300-ohm, L1, L2 and L4;
One iron-core choke coil; 10-milliampere, 30-henry, L3;
Two filament rheostats; 3-ohm, 1.5 ampere, R1 and R2;
Two potentiometers, 400-ohm, R3 and R4;
One potentiometer, power type, 5,000-ohm, R5;
One fixed resistor, center-tapped wire-wound type, 5,000-ohm, R6;
One fixed resistor, wire-wound type, 10,000-ohm, R7;
One fixed resistor, 100,000-ohm (to protect the filter condensers from the high potential developed if the high-voltage plate circuit opens. It may be omitted if desired), R8;
Three filter condensers, 4-mf., 1,000-volt, C1, C2 and C3;
One UX tube socket;
One rectifier tube, 216B or 281 type, V1;
Nine battery clips;
One baseboard, 11 x 17 x ½ inches;
One bakelite front panel, 7 x 18 x 3/16 inches;
Eight rolls of flexible insulated hook-up wire, white, salmon, brown, green, black, blue, yellow and slate. (This code corresponds with the Neutroheterodyne diagram given in the preceding article.)

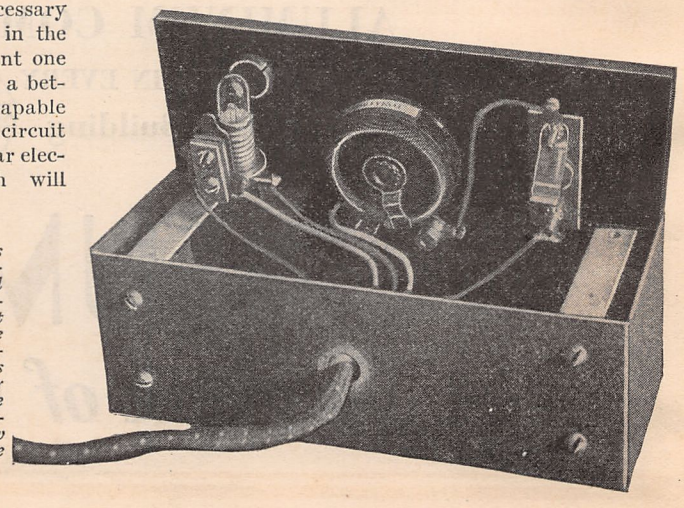
A Simple Remote-Control Device

(*Continued from page 49*)

Here, in order to keep the 110-volt circuit out of the remote control, a small "local" battery (several dry cells) is used to actuate the relay. This closes the 110-volt circuit, the current of which, in turn, passes through the primary of the transformer, the secondary windings of which heat the filaments of the A.C. tubes. Of course, the use of a local battery in the relay circuit is not exceptionally good practice, because sooner or later the batteries run down and then the relay will fail to work. It is for this reason that Fig. 5 has been drawn. Here we have full A.C. operation of both set and remote control. *The relay for use with a local battery should be of the high-resistance type.*

However, it will be necessary to make a few changes in the device, the most important one being the employment of a better and heavier switch, capable of handling the 110-volt circuit without trouble. A regular electric-light toggle switch will probably be best for this purpose. The wiring, too, will have to be changed, for the (comparatively) lightly-insulated material used for the battery cable will not be very well adapted to carrying this higher voltage. Then, too, it is necessary to keep the wires handling this current entirely separate from those carrying the loud-speaker circuit, as their close proximity might cause a bad hum.

The wires to the variable high resistor will be the same as those used in the others and they will be connected in the usual way. The other three wires, though, will be connected to the lighting mains and the transformer as shown. This, of course, takes it



The remote-control box is opened here to show the location of the few parts and the simplicity of its construction. At the left, the pilot lamp behind its jewel; in the center, the 0-50,000-ohm variable resistor which controls the volume of the speaker or phones plugged in; right, the speaker jack. The combination shown here will allow the option of using phone plug or cord tips.

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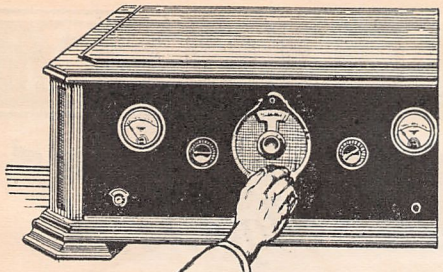

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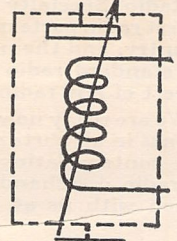

Note the special symbol which had to be designed to designate the Peridyne, as no other character in radio practice properly identified it.

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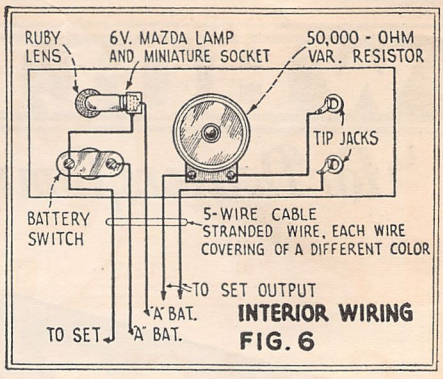
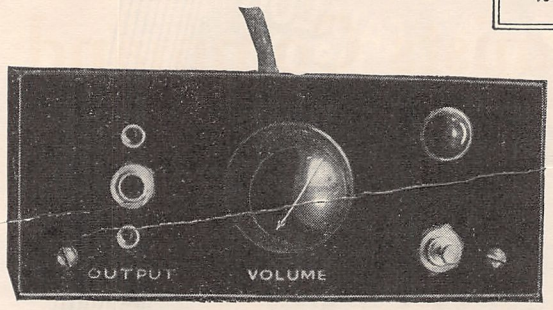
for granted that the "B" supply device is fed from the same transformer that feeds the filaments of the A.C. tubes; if a separate eliminator is used, it should be connected in parallel with the filament transformer in such a way that the switch in the remote control will work both together. This is not a difficult thing to work out.

The volume control in the remote-control unit makes it possible to use a loud speaker in one room and a pair of head receivers in another; because, by introducing more resistance into the circuit, the volume may be reduced at one outlet only. The device is so small that it may be conveniently placed on a table or the arm of a chair; the five-wire cable being run under a rug to the baseboard, where it may be stapled and run to the set. The ideal way is to have the wires in the wall, with outlets as needed in various rooms. The loud speaker may be carried about from room to room; or there may be a separate speaker on each remote control, which is more convenient in many ways, if this luxury can be afforded.



INTERIOR WIRING
FIG. 6



Above, the wiring of the remote-control device in pictorial form. Its simplicity is seen at a glance. No specifications are given for the panel and box; as the experimenter may construct them to suit his apparatus. That illustrated here is about six inches wide, two inches high, and two inches deep. Set in a wall, it is a neat fixture; or it may be used as a portable control in the manner illustrated in the heading of this article.

The Passing of the Third-Floor Quack

(*Continued from page* 15)

tells me to wait a few moments. A couple other patients are ahead of me.

It's half an hour before the White Sister tells me to come in. The consultation room is empty, but as soon as the nurse leaves the Doc enters.

"Mr. Hammerstein, of the *Inanities* last season?" he opens, and somehow I just can't help liking the guy. He's about thirty-five, brown-haired, athletic, and a handsome cuckoo all told.

"My billing," I concedes. "Are you a show fan?"

"Rabid," smiles the doctor. "What can I do for you?"

My part's all been gone over, so I opens with the customary recommendation. "One of the girls in our chorus—*My Radio Girl,* opening in a few weeks—showed me a radio belt of yours, and claimed it did her heart a great deal of good. I've a hunch my ticker may have been strained in some dance numbers I did, and I'd like to get one of your outfits as a safeguard."

The doctor nods. "I shall examine your heart, first, to see if you require treatment. My belt is hardly a panacea; many cases are too far gone for any earthly assistance. If your organ is in perfect condition, the belt would be of no value; to the contrary, it might prove a detriment. The Tolman Radio Breast Belt is primarily designed to assist those whose heart action is inherently sluggish. Too much electricity would, of course, over-stimulate, and result in considerable strain. Therefore, the belt must be made to order for each individual."

A pretty speech, and it sounds sincere. If this guy's a crook, he's a genius. He listens to my heart about ten seconds and smiles.

"If all hearts were as sound as yours, Mr. Hammerstein, we doctors would be in the bread line shortly," he states. "You have nothing to worry about on that score."

"Then I don't need a belt?"

"Sadly for me, you do not," he laughs, "although there are so many who do that it is a pleasure to find one whose most important organ is functioning properly."

"And the fee?"

He waves me away. "I'm delighted to have met you, Mr. Hammerstein," he says, shaking hands. "I shall make it a point to attend your opening performance."

"I'll try to send you a couple of passes," I promises. "But if I run across anyone who might benefit by your belt, I'll bring he or she up myself—come to think of it, I do believe I know someone who'd be glad to try your apparatus."

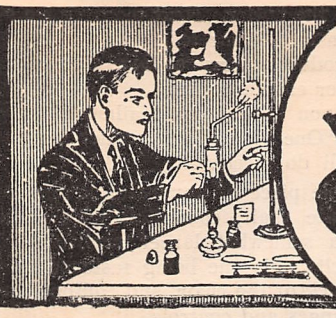
"Do so, by all means," he smiles, bowing me out, and I'm halfway downstairs before it dawns on me that I've been cottoning to a gyp. The fellow was so congenial—

"Well?" asks Jerry, when I meets him at the drug store.

So I tells him the yarn. "And the funny part is, the doctor seems to think he's legitimate. Most fakes will sell anybody anything, but not this bozo. And such a pleasant mien—I promised him two passes, and I'm going to see that he gets them!"

"Then you didn't get any technical information?" asks The Master, disappointed.

"I'd have lost it before now if I had," I answers. "He won't sell you a belt unless you need it—do you know anyone that has a weak heart?"



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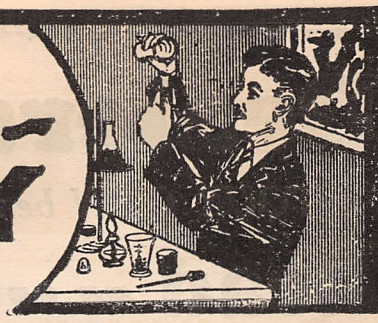

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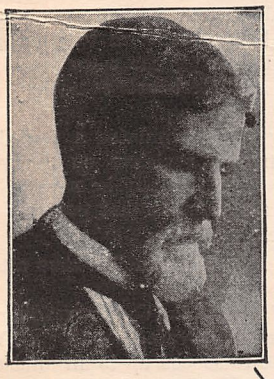

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Jerry pauses in contemplation. "Several, but I fear they would be unable to conceal the true motive of their visit," he says. "Let me see, now, there's—why, how odd! I never thought of myself!"

"You!" I exclaims. "Is your pump bad?"

"Nothing to be alarmed over," he replies, "but my heart is naturally a bit sluggish."

"Sluggish!" I repeats. "That's the very word—'those whose heart action is inherently sluggish'—you're it!"

Jerry muses again. "That's all very well, but how am I to get in? He might not recognize me, but, on the other hand, should he know who I am our purpose would be lost. I'm afraid I'm out."

"Not at all, not at all," I disagrees. "Have you never heard of Sherlock Holmes?"

"You mean a disguise?"

"Very keen," I applauds. "And I know the baby to do the job. Danny McKee is the slickest makeup man that ever came out of Hollywood. He even made Lon Chaney look like Lon Chaney."

The Master's not so certain about the idea. "Makeup for the stage is one thing, Joe, but when closely inspected—"

"Drag along!" I commands. "You've never met Danny!"

I take him down the Rialto to McKee's costume shop, give the password and get into Danny's private workroom. You may not be hep, but a lot of people sorta want a few changes made now and then, and Danny's the fair-haired boy they dingle when they need a new map. I'll concede that most of his customers have been photographed front and side, and a large part of the others eventually will be mugged likewise; you've got to be known to get into his sanctum.

I've been friends with McKee for twenty years, ever since I was a kid with my old man's hard-shoe act, and Danny's something of an uncle to little Joe. He greets me intimately, although he kinda shies from The Master.

Until now it hadn't dawned on me that Jerry is a detective, connected with a famous international agency, and as such not warmly welcome at Danny's. But I don't mention it, and The Master's forgotten for the time being.

"I require a temporary disguise," begins Jerry, "one that will be quite convincing when closely scrutinized. It must necessarily take in my whole body at least down to the waist."

Danny looks him over. "Skin's the hard part," he says. "But I can fix you so's you'll pass for forty. That do?"

"Fine," agrees The Master. "Start at once, please."

McKee's an artist, no fooling. First he darkens Jerry's face and body to a rugged tan, indicative of exposure to the elements. Then he greys the temples and eyebrows, accentuates the jowls and puts slight paunches beneath the eyes. When he's through, The Master looks like a seasoned globe-trotter of forty-five, and you can't tell the makeup even right next to him.

"How about getting this stuff off, later?" asks Jerry.

"It'll wear away in a month or so," smiles Danny, "but don't try to get rid of it yourself. When you're through, come back here, and I'll remove the signs of age."

We goes back to Brightmere, and if I hadn't vouched for him Jerry'd never have got past the butler. Next morning we goes in to consult the medic.

I introduces Jerry as Mr. Gerard, and the doctor examines him.

"Yes, you have a small ailment," he declares. "One of my belts, under low pressure, will do nicely."

The sole piece of apparatus in the room is a white chair, connected with nothing except a somewhat larger replica of the Doc's belts, this one being fastened to the upper back of the chair, and equipped with dials, gauges and controls.

"This test is imperative, else one might be killed while passing a large broadcast station," he explains, strapping the belt onto The Master, who's seated in the chair. "By finding your normal resistance, I can make a belt to conform to your particular needs. Please tell me when you first begin to feel an electrical sensation over the heart."

Slowly he manipulates a few dials, and faint surprise registers on Jerry's made-to-order face. Finally he says "Now."

"It is apparent at that point?"

"Quite."

"Now tell me when it ceases altogether."

Jerry does.

"Hm," grunts the doctor, reading a meter. "A rather aggravated condition. You seem insensible to shocks up to an unusually high pressure. However, I shall make you a belt, and later examine you to see if we cannot lessen the potential."

"When will my belt be ready?"

"Tomorrow, but I have one here that is slightly less powerful than you require. You may use it until your own is ready. Be in at two o'clock and let me know what experiences you may have felt."

The Master and I drove to town in his closed laboratory truck, which is parked out of sight around the corner. We enters it and Jerry quickly opens up the belt. It consists of two small fixed crystal detectors, a condenser or two, and about five hundred turns of number twenty cotton-covered wire, this latter terminating in two contacts that come opposite each other when the belt is on, the heart being between the two ends. That's all.

"An elementary radio receiver!" snorts Jerry. "Why, this thing couldn't produce a shock—yet, I got one from that chair belt—well, I'll be damned!"

I keeps silent, and the next afternoon, when we goes back to the office, The Master slips me a gat, telling me to follow his lead.

The doc ushers us in himself, this time, and brings out the belt. Jerry says he wants to put it on now, so we goes into the examining room. Quick as a flash the Master makes a dive for a door behind the chair, and before the doc can stop him he's exposed the nurse and what proves to be the primary side of a set-up transformer.

"How dare you!" snaps the doc—to face Jerry's automatic.

The Master displays his badge. "Dr. Tolman, you are a deliberate crook!" he states. "From the first I knew that no radio wave could produce the shock I received, yet this test belt was quite unconnected. Now I understand—the belt is the secondary—you made your patients believe that they would get shocks elsewhere by giving them one here. Very, very clever!"

"It's a lie!" shouts the doc. "I can prove that—"

"Yes?" drawls Jerry. "Will you take

this test chair out to my home and give me a shock there?"

This goals Tolman, and he flops onto the examining chair. "You win," he mutters, as two Central Office dicks come in and give him and the nurse—his wife—a ride in the black bus.

Idly, Jerry attempts to remove the make-up. "Oh," he says, coming out of his trance, "it won't come off. I'll have to see Danny."

"Which reminds me," I points out, "that McKee was raided last night, and is in the bastille. You'll have to let it wear off."

"Not while Danny's alive!" yelps The Master, rushing downstairs to the jail. I laughs, and sits there, fiddling with the belt. Someone comes in. I looks up. It's Elaine, with Millicent tagging for company.

I finally convinces Elaine about things, but Millie's in the dark. She points to the belt. "What's that?" she asks.

I heaves a sigh. "That," I states, "is my little stray ohm in the vest."

FINIS

(*Copyright, 1928, by Robert Francis Smith*)

A. C. Tubes Require Special Wiring Care

(*Continued from page* 39)

and even the 210-type tubes, ordinary flexible hook-up wire is sufficient to carry the currents in the filament circuit.

In the average five-tube electric receiver, using three 226-type tubes as radio-frequency amplifiers, and in the first audio stage, a 227-type as a detector and a 171- or 210-type in the last stage, the three 226-type tubes draw over 3 amperes; while the 227-type tube takes 1.75 amperes. If a 227-type tube is used also in the first audio stage, the current drawn by the two R.F. tubes will be over two amperes, while that drawn by the two 227-type tubes will be 3.5 amperes. The No. 20 wire used in most hook-up and battery cables is not large enough for use under these conditions. In addition to this, appreciable resistance in the wiring may unbalance the filament circuits, introducing hum.

Rubber-covered twisted pairs, not smaller than No. 18, should be used. If obtainable, No. 16, or even No. 14, is to be preferred.

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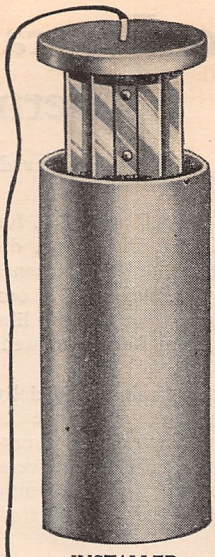

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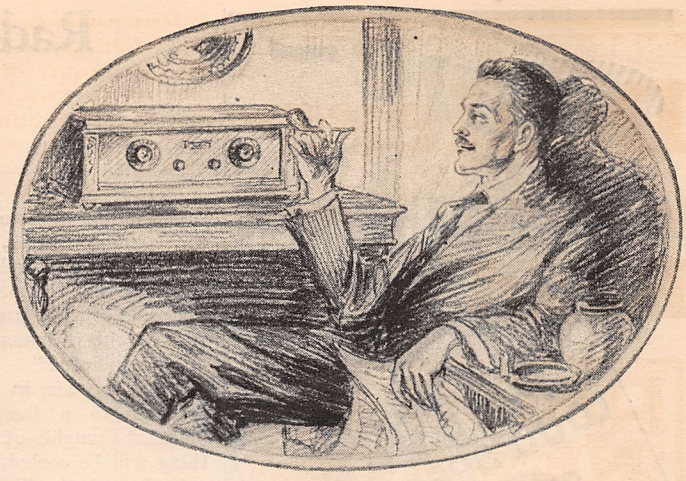

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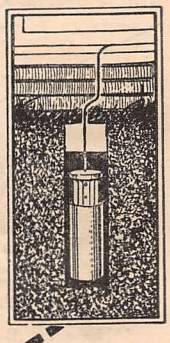

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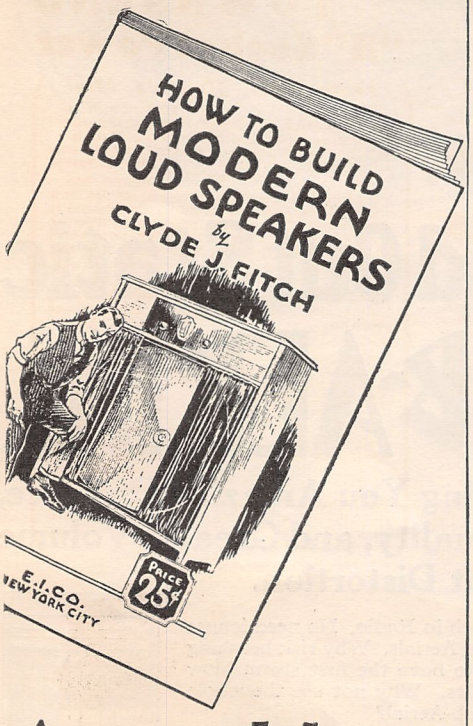

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Radio Programs to Suit the Thermometer

(*Continued from page* 17)

Discussing plans of WEAF and WJZ for the coming months, G. W. Johnstone, director of public relations of the National Broadcasting Company, remarked: "If our July and August programs don't sound like relayed entertainment from Labrador, we'll be disappointed."

With the air in the studios artificially reduced to a temperature conducive to pleasant thoughts of far-north climes, everything will be cooled, except the announcers' voices; and they'll hold a genial warmth, guaranteed not to hurt on the hottest afternoon.

LIGHT PROGRAMS

All heavy stuff is being eliminated from the schedules. Wagner as interpreted by heavy baritones and mellow contraltos may be beautiful in November, but it is not so good in July. And so whatever operatic aspirations are given voice, from now until the arrival of fall, will be the lighter type in which high C's and pale moons will predominate.

Tense drama is off the air boards for the next twelve weeks and in its place, wherever the theater makes contributions, will be bright comedy, young romance and scintillating themes.

Dance music will be as pepped up as ever but, instead of hot notes of heavy brass predominating, the tintinnabulations of silver notes will fill summer nights with pleasant sounds.

Alfred J. McCosker, director of station WOR, promises that his programs will be so in keeping with the concerted effort to offset the weather bureau's daily bad-news bulletins that the station's chimes will sound like Eskimo bells to the listeners.

Mrs. Isabelle Turner, who is responsible for many of the bright spots on WRNY's programs, has her eye on the calendar in planning the coming days, so that what emanates from the studios at the Roosevelt Hotel will be as welcome to her listeners on July afternoons as a cooling pitcher of iced lemonade.

CONTAGIOUS COOLTH

In fact, the general idea right now is to frigidize the music and freeze the ether atmosphere so realistically that a receiver next month will make a sun-filled porch seem like Greenland and the living room reminiscent of piney, breezy mountain retreats. And who won't welcome such an effort?

With broadcasters so seriously bent on service and radio manufacturers offering modern equipment to offset the static bugaboo, a successful summer at the loud speaker is assured.

An indication that commercial warm-weather broadcasting has lost its hazards is emphasized by the intention of most of the "toll-time" accounts to hold their regular places on the air. They, too, must adjust their medium to the season and their plans are in keeping with the general schedules of the stations on which they are heard.

The fundamental idea in broadcasting arrangements for humid days and warm evenings is to alleviate the discomfort of those in the heated areas. Not only from an entertaining angle but with an instructive, helpful aim, every hour will carry some useful or amusing message. In the daytime programs, domestic-science experts will tell housewives how to prepare summer meals and how to protect themselves and their children as much as possible from the warm weather.

Experts in health will give their valuable advice and the entertainers will do their best to keep a million eyes off the weather indicators, even if it's too hot to do anything but listen.

For those who are more fortunate and can rush away from crowded places to the resorts, the radio will be an added boon. But, from already maturing plans, a receiving set this summer will go a long way toward overcoming some of the disadvantages of a season that brings flies, mosquitoes and considerable hot air.

What Is the Life of a Fixed Condenser?

(*Continued from page* 32)

HOW LONG CAN IT LAST?

The aim of manufacturers of high-quality paper filter condensers is usually a minimum life of 10,000 hours; or about ten years of normal radio service in the home. In actual tests, however, condensers have often indicated a life of from 30,000 to 60,000 hours; which may well be considered radio infinity in view of the rapid changes in the radio art, rendering any equipment obsolete within a few years at most.

The question is often asked, "What is the precise nature of the breakdown in filter condensers." Well, a condenser invariably breaks down at the weakest point. In fact, testing serves to check up on design quite as much as on condenser making; since the engineer learns the weak points of his work from the results of condenser tests.

In the course of production, filter condensers are tested to detect defective units. In some cases, condenser sections are "flash-tested" at about five times the rated working-voltage, and again "flash-tested" at two to three times the rated working-voltage when assembled in blocks. However, flash tests are only a check on dielectric strength and as a safeguard against defective units; they give no assurance of the probable life of a condenser in actual use.

HIGH VOLTAGES ARE DEADLY

The matter of condenser life is one which has hardly received sufficient attention from set builders. When it is borne in mind that the elaborate electrified receivers and radio-power units of to-day can be no better than their filter condensers, and that

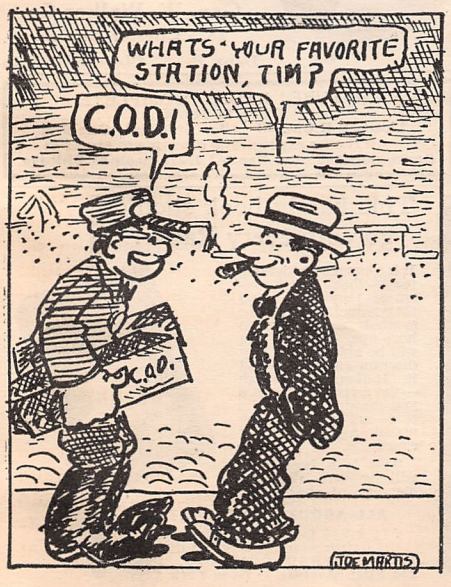
a broken-down condenser means much time wasted in trouble-shooting as well as in costly replacements, the matter assumes due proportions. Furthermore, even at this late date, many engineers and radio set builders fail to appreciate the accelerated wear and tear on condensers brought about by applying voltages in excess of the true working-voltage.

It will be noted that we mention "true" working-voltage, which means just what it says to the user; whereas "test-voltage," "tested at——," or "voltage rating," may mean little or nothing. However, a 10% overload has been found to reduce condenser life by 50%. Furthermore, *if the voltage is doubled,* the condenser life is reduced to *one-thirtieth of its expected span.*

While these facts may appear appalling on the one hand, they are advantageous on the other. They permit of "accelerated" life tests, whereby it is possible to determine condenser life quite accurately in but a fraction of the time which would be required for a normal life test. There are less than 9,000 hours in a year. Therefore, to determine the life of a good condenser, it would require more than three years of test at normal working voltage to determine a 30,000-hour life. Instead, the "accelerated" life test applies double the voltage; so that the actual number of hours obtained may be reduced to a thousand hours in this case, or approximately 42 days.

Incidentally, it may be remarked that there is a difference between direct-current and alternating voltages. An alternating-current voltage which is nominally only 110 volts rises to a value of more than 110 volts—as high as 155 volts—twice in every cycle, first one way and then the other. So, also, the action of the alternating current on the dielectric is one of swinging its particles, first one way and then the other, say 120 times a second. For that reason, an alternating voltage of a certain rating puts much more strain on electrical apparatus than would that of a battery, say, which is rated at the same figure. It will be noted that the breakdown voltage of a condenser should be given as an A.C. rating; and that it should be as high above the actual voltage to which the instrument will be exposed as may be economically possible.

IT'S A LOCAL



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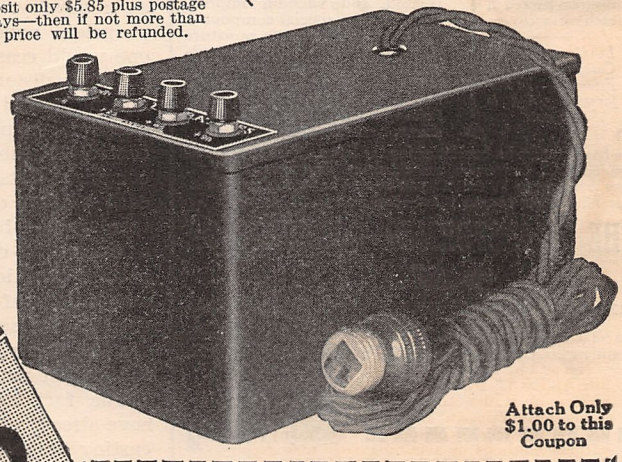

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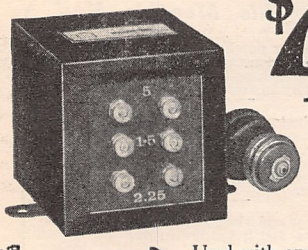

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How Many Stations on One Wavelength?

(*Continued from page* 16)

INCREASED RECEPTION STRENGTH

A great increase in volume would, it is very likely, be noted, due to the added signal received from a number of stations. The sensitivity of the receiver could therefore be decreased, resulting in clearer reception and more freedom from static disturbances.

There would be no necessity for having more than one local station broadcast a certain program, as sometimes done now.

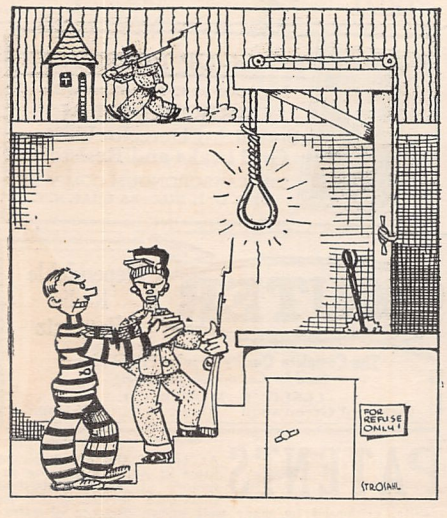
It would not be necessary to limit the number of stations on a given chain; the more the better. If the closely-populated portion of the country could be provided with a 500-watt station every fifty miles for each chain program, perfect reception of that program could be obtained by everyone at all times, regardless of reception conditions.

Better reception conditions would increase the audience served, enhance the value of programs broadcast, and benefit the broadcaster and the advertiser as well as the listener.

A "distant-reception night" could be held as a novelty: at a certain time after appropriate announcements, all stations but one would cease broadcasting, and listeners at great distance from the one still transmitting would attempt to hear it. As it would not be necessary to change the tuning controls, it should be an easy matter to accomplish distant reception. One by one, each station on the chain would in turn take up the broadcasting, giving everyone a chance to easily find out the distance-getting qualities of his receiving set. Many adaptations of this scheme will immediately suggest themselves, such as providing prizes for the one who could verify reception of the largest number of stations, etc.

The fact that two neighboring stations have already accomplished the feat of broadcasting the same program on one frequency indicates that the day may soon come when all chain programs will be broadcast on the same frequency. Many look forward to this with great eagerness.

RADIO TERM ILLUSTRATED



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Your Set Can Now Get Short Waves

Sent anywhere in the U. S. post paid upon receipt of price. Canada and Foreign, 60c additional. Money order only. Also sent C. O. D. plus postage in U. S. if $1.00 accompanies order to insure carrying charges. In ordering be sure to name set and tubes used, such as UV199, UX199, WD11, 201A, UX226 or UY227. Price $15.00 or $17.50 for A. C. Sets.

The SUBMARINER

will convert your regular set into a short-wave receiver by simply inserting a plug in place of one of the tubes. This takes but a few seconds. With "Submariner" it will enable you to tune between 26 and 68 meters.

This device operates with all sets, such as T.R.F., Neutrodyne, Super-Heterodyne and others. A C or D C operated. No additional tubes, batteries, or coils required. If set operates a speaker it will do so with "Submariner" attached. Operates a wave changer with Super-Heterodyne and as detector unit with others.

SHORT-WAVE RECEPTION

is practical, and especially in summer, as they penetrate better and there is less static. The "Submariner" waveband includes practically **All Powerful Stations Which Broadcast Programs.** You may also listen to amateurs from all parts of the world who transmit code messages. You will have one of the most efficient short-wave receivers when the "Submariner" is attached to your set. Get a "Submariner" so you may have command of the short-wave activities as well as the broadcast band. If your Dealer does not carry

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This handy book should go with every Radio!

It is concerned with radio parts—their functions—where they are — and their names. It gives the symbols used in radio hook-ups, so that you will be able to read any diagram and understand it. It discusses air waves —the aerial—then takes you through every radio part—and finally the actual reproduction of sound.

This is a book that will give you a full understanding of your set.

ALL ABOUT RADIO PARTS
5½ x 7½ inches, fully illustrated
Get it from any newsstand or direct
THE CONSRAD COMPANY, INC.
230 Fifth Avenue New York City

Radio Aids Marine Fire Fighters

(*Continued from page* 13)

During the second day of the field-strength tests there was an unexpected demonstration of the value of this plan in case of emergency. The fireboat was proceeding slowly up the Hudson River, keeping in constant touch with the shore station, when word of a fire on the Brooklyn shore was received at WNYC. The tests were at once interrupted and word was flashed to the *Mitchell* to proceed directly to the scene of the fire, and report just how serious it was. In record time the *Mitchell* arrived on the scene and was able to report back that the fire was well under control and that no additional assistance would be required.

Following the field-strength tests, the two transmitters were changed slightly, and equipped for radio-telephone communication for the purpose of a public demonstration. The captain of the boat was then ordered to proceed out into the harbor and city officials, stationed ashore at one of the fire boxes equipped with a microphone, issued orders to the craft by means of the radio transmitter. For this purpose the microphone was connected to the control room of the shore radio station by means of special telephone lines.

Plans are now being made for additional tests which, if successful (as there is every reason to believe they will be) are expected to lead to the installation of suitable radio equipment aboard all fireboats operated by New York City.

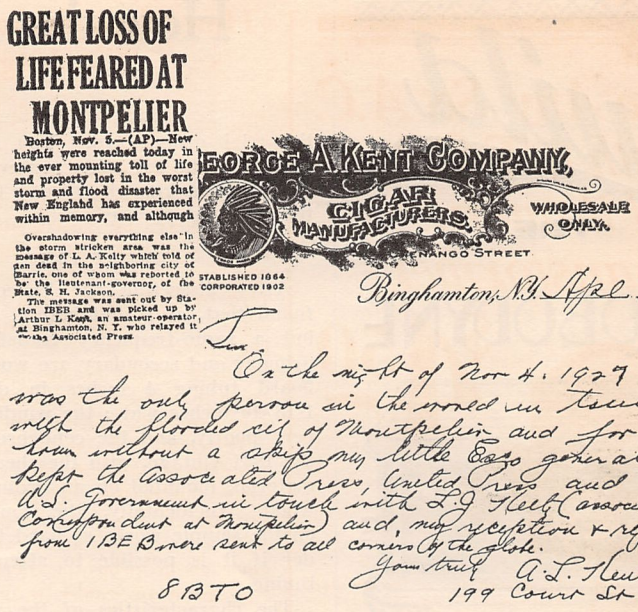
Obtaining Current Supply for an Electrodynamic Speaker

MANY owners of electric receivers, who have purchased new electrodynamic loud speakers in an effort to obtain the utmost in radio reproduction, have found themselves confronted with a very perplexing problem. Unlike others, an electrodynamic unit requires an external source of direct current to excite its special field winding, and the speakers will not operate unless this power is supplied. The amount of current consumed by the field coil varies in different speakers, but most units need approximately ½-ampere D.C. at 6 volts. However, this potential is not available in circuits where the tube filaments are heated with alternating current.

Nevertheless, this current may be obtained very easily from a standard trickle charger; as the current used by the field coil need not be pure D.C., and any rectified A.C. of the proper voltage will give satisfactory results.

AN INGENIOUS METHOD

In addition to the electrodynamic speakers which operate at low voltages, there are other types which require a potential of 100 volts or more at a current of approximately 50 milliamperes. When using a speaker of this type in connection with an electrified receiver the power may often be obtained by using the field coil of the loud speaker in place of the filter-choke coil in the "B"-power unit.


GREAT LOSS OF LIFE FEARED AT MONTPELIER

Boston, Nov. 5.—(AP)—New heights were reached today in the ever mounting toll of life and property lost in the worst storm and flood disaster that New England has experienced within memory, and although

Overshadowing everything else in the storm stricken area was the message of L. A. Kelly which told of ten dead in the neighboring city of Barre, one of whom was reported to be the lieutenant-governor, of the State, S. H. Jackson.

The message was sent out by Station IBEB and was picked up by Arthur L. Kent, an amateur-operator at Binghamton, N. Y. who relayed it ... Associated Press

GEORGE A. KENT COMPANY, CIGAR MANUFACTURERS, WHOLESALE ONLY, ENANGO STREET, ESTABLISHED 1864, INCORPORATED 1902

Binghamton, N.Y. April 9 1928

Sir—

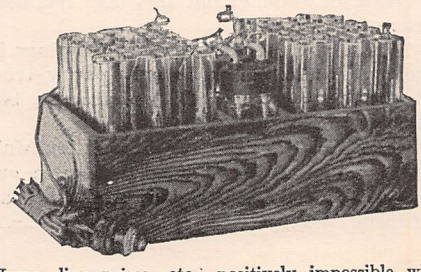
On the night of Nov 4. 1927 I was the only person in the town in touch with the flooded city of Montpelier and for 24 hrs without a skip my little Esco generator kept the Associated Press, United Press and U.S. Government in touch with L.J. Heltz (Associated Press Correspondent at Montpelier) and, my reception + reports from 1BE Boston were sent to all corners by the globe.

Yours truly A.L. Kent
199 Court St

8BTO

ELECTRIC SPECIALTY COMPANY
TRADE "ESCO" MARK
211 South Street Stamford, Conn.
Real DX means maximum miles per watt, and that is what ESCO" generators are built for

90 Volt Power Unit :: $12.75



Hums, line noises, etc., positively impossible with this new advanced unit. Plug in and forget. Non-acid and noiseless. All detector and intermediate voltages plainly marked. Simpler to hook up than dry cells. Operates any type set 1 to 12 tubes. Greater volume and clearness guaranteed. If not thoroughly satisfied return after using 30 days for complete refund. Guaranteed further 2 years. For 110-120 volts A.C. 25 to 60 cycle current. 90 volts, $12.75; 112½, $15.25; 135, $17.50; 157½, $19.50; 180, $24.00; 202½, $26.00. Also built for D. C. current 110 and 32 volts at only $3.00 additional, any size above. Ample stocks—same day shipments. Simply say—ship C.O.D. or write for my interesting literature, testimonials, etc.

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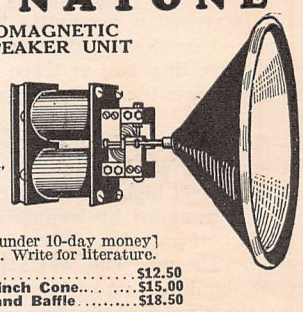

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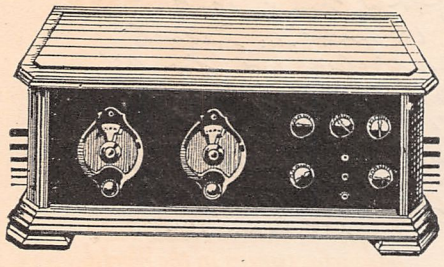
Build THE STROBODYNE



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Of course CONSRAD, the oldest and original radio pattern publishers, were given the task of publishing complete instructions for the building of an efficient STROBODYNE RECEIVER. In designing the best and most comprehensive instruction material, they have excelled. The STROBODYNE PATTERN BY CONSRAD contains four full size blueprints and a special 16-page instruction booklet that answers fully every question on STROBODYNE construction.

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How the Radio Public is Fooled

(*Continued from page* 29)

the trial order card. You will get the greatest radio reception you ever heard and the money-making chance of a lifetime. Mail the card today, sure."

WHAT IT IS

After dissecting the "Kleer-Tone," we found that, as stated before, it is nothing but a radio-frequency transformer. The primary and secondary are wound on cardboard tubing 4 inches in diameter and 1-13/16 inches wide; the winding was done very poorly, and the condenser used is of the 1921 vintage, with the cheapest kind of material, mounted on an ordinary piece of wood. Incidentally, the condenser knob on the sample works so hard that we wonder if it is possible to attempt any fine tuning.

The characteristics of the windings are as follows: primary, 9 turns of No. 26 D.C.C. wire; secondary, 31 turns of No. 26 D.C.C. wire. The device has an inductance of 157 microhenries. The tuned circuit of the secondary and condenser covers no more than approximately 400 meters.

This, then, is the well-known, old-time and time-worn device, commonly known as the ordinary or garden variety of wavetrap.

WHAT IT ISN'T

The statement that the device eliminates 50 to 90 per cent of static is, of course, untrue. This device no more eliminates static than a pair of suspenders would.

The second claim is partially true, that with some stations there may be a slight increase of volume; but this does not hold true of all stations.

The third claim, that the device brings in more distant stations, is only partly true. It does not do so on all wavelengths, but only on some.

Claim No. 4 is perhaps the most truthful; in that the device actually will tune out powerful local stations, but, again, not all of them.

Claim No. 5, which claims that the "Kleer-Tone" gives your set at least one more stage, is not at all true, and cannot be substantiated.

As to No. 6, the "Kleer-Tone" does not separate low-wave stations any more than high-wave ones, and does not do so on all stations.

No. 7, the claim that the device saves from 30 to 40 per cent on batteries, is a 100% untruth; it does nothing of the kind. The inference here is, no doubt, that on some stations where the "Kleer-Tone" brings the radio set into resonance, if your set is such an antiquated device, it will undoubtedly make it possible to turn down the rheostats. On most modern sets this will not be true at all; and it only can hold true for a few stations, but certainly not for all, on the old models.

SAVE YOUR MONEY

Yet, this famous Geppert "Kleer-Tone" sells for $4, when devices as good or better can be bought for as low as $1. If this were advertised as an ordinary wavetrap, and it was honestly set forth that the device is useful to separate some stations and help to make your set tune sharper, no one would find fault with it; but the rest of the claims are simply plain bunk, and some deliberate untruths. The device, however, has one great redeeming feature, and this is the only good one that we could find. The bottom is covered by a piece of felt, so that it will not scratch your radio.

It is such claims as we reprint above that make the public weary of everything in radio today, and, the sooner some manufacturers learn this lesson, the better it will be for them. They have, of course, the right to take a certain amount of poetic license in some of their advertising copy; but the thing becomes vicious when too many liberties are taken and when deliberate statements, that can never be substantiated, are made.

Experiments With a Double-Ground System

By W. H. Griffith, M.D.

SOME time ago the writer accidently discovered that, if the far end of an ordinary single-wire aerial is grounded instead of being insulated from the ground, the signals may be actually increased in strength. They are not diminished or destroyed, as one might expect. Since then two or three references to this fact have been seen in radio publications.

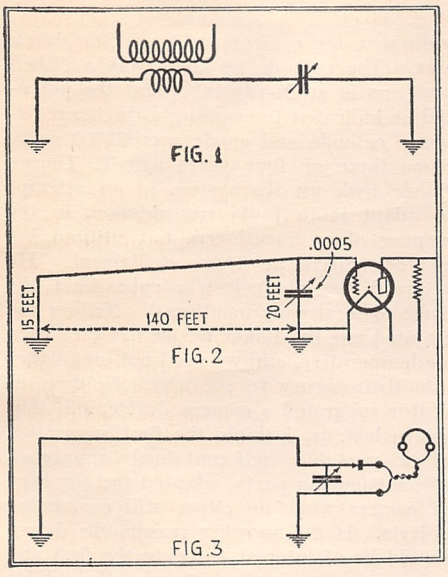
A single-wire aerial was constructed; 140 feet long, 20 feet high, at the end near the set and 15 feet high at the far end. The far end was grounded by leading a wire down to a piece of gas pipe driven 6 feet into the ground. The near end was attached to the "aerial" binding post of the set; and a wire from the "ground" binding post was attached to a water pipe in the basement. This arrangement gave much louder signals than were being obtained with an ordinary aerial about 100 feet long.

Then, with the idea that the new aerial might be too long, a .0005-mf. fixed condenser was put in series; and this seemed to be an improvement. The next step was to replace the fixed condenser with a .0005-mf. variable, to determine what capacity was best to use. It was found that there was an optimum setting for each wavelength in the broadcast band, although it was not critical. The operator was in reality *tuning a big loop* (Fig. 1).

ONE BIG COIL

As the next logical step, the writer tried connecting the aerial direct to the grid of the first tube, and the ground (in the base-

ment) to the filament; and shunting the variable condenser between the aerial and ground. This was actually tuning the loop as a loop is usually tuned (Fig. 2). The



The upper picture shows the double-ground system, which obviously becomes a true loop, if we complete the circuit as in Fig. 2; which has been used successfully, as well as the crystal hook-up in Fig. 3.

effect was indeed surprising; this loop, made up of about 180 feet of wire (including lead-ins) and 140 feet of earth, tuned almost as sharply as the ordinary indoor loop. Previously-weak stations now came in with good volume, selectivity was actually improved, and the ratio of signal to static seemed better than with the ordinary aerial. The condenser used covered the entire band nicely.

As a critical test, a *crystal* set was assembled; using the antenna as described, the variable condenser, crystal and phones as in Fig. 3. Two Chicago stations, WBBM and WGN, and also KMOX, St. Louis, were heard in one evening (January 23, 1928) and WGN was heard two other nights the same week. Each of these stations is about 600 miles from the writer's residence at Huron, South Dakota.

The writer's present set, which is a seven-tube tuned-radio-frequency affair of less than average efficiency, receives almost everything in the country when using the new aerial, reception being limited by the noise level and congestion of stations. No directional effect is noted. Daylight reception from WCCO, WHO and WOW is especially good. These stations come in every day with volume sufficient for an auditorium. It is an interesting fact that the above stations, which are about 300 miles away, come in with almost the same intensity day and night; while Chicago stations about 600 miles distant are heard very poorly during the day.

So far as the writer knows, this particular type of antenna hook-up is something new. In "Radio Engineering Principles" by Lauer and Brown (McGraw-Hill Book Co. 1920) there is mentioned the type of circuit shown in Fig. 1, and there have been other similar arrangements using two grounds.

EXPERIMENTAL POSSIBILITIES

The circuit of Fig. 2 is quite different, however, and a marked difference was found in results obtained by the two methods. Whether it is new or not, it is thought to be worth directing attention to. The present tend seems to be toward greater amplification of weak signals from a loop or short aerial; but aerial wire is cheaper than tubes and the cost of maintenance is nil.

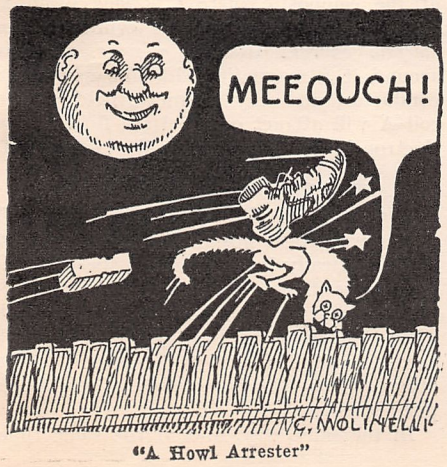
The length of this aerial will limit its use as it will not be adapted to congested districts. A shorter aerial with a larger condenser might give good results.

Another disadvantage is that it introduces an extra control; but the controls can be kept down to two by ganging the other condensers of the set.

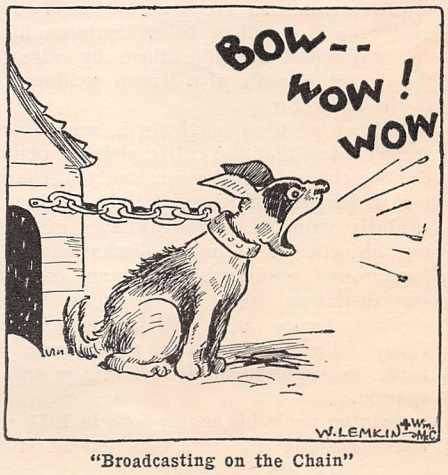
A number of possible uses for the arrangement have been suggested, but the writer has made no effort to investigate them. One of them is the question, how well it would function as a transmitting antenna? He does know that his set can be made to radiate, if deliberately forced. He would not advise anyone to use this aerial with a set that radiates unless he wants to have the neighbors on his neck.

Another question is the adaptability of the system for use in short-wave reception. The working out of the proper size of aerial and condenser for various bands should provide considerable amusement for anyone so inclined.

Radio Terms Illustrated



"A Howl Arrester"



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Vacuum Cameras to Speed Up Television

(*Continued from page* 23)

AMPLITUDE MODULATION

To look at it from another angle, we have an oscillator with a 500,000-cycle frequency. We couple to that a microphone by some magnetic or electrostatic method, and introduce the 1,000-cycle note. What happens? The oscillator's output-frequency changes; we create a sort of heterodyne. Suppose, instead of that, we could maintain our oscillator frequency constant (by means of crystal control, if necessary) with a *resistance* in the oscillator circuit, and find some way to increase or decrease this resistance on all except 1,000 of the oscillations.

Nobody knows yet how to do this, but it may be solved by some photoelectric device. Perhaps we could include a film of selenium in the oscillator circuit and have on the microphone diaphragm a mirror reflecting light to the selenium cell, thus modulating the power output, the *amplitude* of the waves, instead of their *frequency.*

Until something of this kind is done, television must go to the short waves, unless it limits itself to simple, small pictures of a few dots per square inch. The other answer is a special dispensation from the Radio Commission, such as was given to WGY to make possible the demonstration of combined wire-and-radio television in Schenectady some months ago.

PIONEER WORK

It is apparent that the three great problems can be solved. The solution to two of them, I firmly believe, lies in the principles of the television "camera" and projector illustrated in this article. Like every other method known, this is based on work done long before broadcasting began. It started with suggestions by the eminent English scientist, A. A. Campbell Swinton. I have made many material changes in his thought, as it was not even theoretically sound when he gave it to the world seventeen years ago. The most notable changes I have made are: (1), in doing away entirely with photoelectric cells in the transmitter; (2), utilizing a closed electric circuit which includes as part of the current path, the electron-beam itself. In the Swinton device, the plate on which the image falls was a collection of cubes of rubidium, potassium, or other substances which discharge electrons when light falls on them. T. Thorne Baker contemplated carrying those electrons as a charge to the floating grid of a transmitter tube. Swinton himself suggested carrying them by wire to the deflecting plate of a Braun oscillograph in the projector.

Neither of these methods is sound; one reason being that the entire plate of photoelectric cubes would be constantly discharging under the influence of light, and particularly with the shifting images of moving objects. This mass discharge, as a *background,* would overshadow any continuous discharge from the scanning by an electron beam; and, without some other change, the floating grid might soon be made so negative as to affect the transmission.

Swinton made his suggestions in 1911 and knew nothing of the two-element tube utilized in the camera and projector shown here. The cathode he knew was a dished plate, as in an X-ray tube, and the potential he indicated for causing a discharge between cathode and anode was 60,000 volts. Some three or four years ago T. Thorne Baker took up the system in an attempt to adapt it to radio transmission, in the manner above mentioned, but utilized the electron discharge from a filament. He retained the photoelectric cubes and the baffle plate already mentioned. Neither the Swinton nor the Baker device has ever been made operative, and we need not go further into their theory to see why. Neither inventor suggested a camera device, and that shown here is, I think, the first suggestion of a portable, self-contained apparatus, without moving parts, adapted for any type of camera work on either still or moving objects. If for no other reason, the design should be of interest as being the first and only suggestion in the history of the art for transforming light into electrical impulses without the use of a photoelectric cell of the conventional type.

THE CLARKSON CAMERA

The theory is simple. Certain vapors and certain liquids, too, are more conductive in light than in darkness. One of these fluids is sodium vapor, familiar to all by having been used in the Donle tube. In the vapor chamber of the television camera (Fig. 1) we may have sodium vapor, and the temperature of the chamber may be regulated by the heating coil H. The wall G of the tube is of transparent material, preferably quartz, and an image may be at will focused on the composite plate C, which is simply a number of insulated, conductive wires or cubes. It may be a bakelite plate in which are embedded small conductors.

In front of the composite plate is a screen S of metal wire, which not only divides the light into rays when an image is projected on the plate, but acts also as a terminal in contact with the vapor.

At the other end of the camera tube is a concentrated filament, or cathode F and a plate, or anode P, which has a tubular opening. With proper plate voltage a flood of electrons shoots from the cathode to the plate; a stream of them passes at high speed through the tubular opening, creating a narrow beam which impinges on the back of the composite plate C. This beam is really a flexible, weightless conductor, *an electric current without a wire.* It has around it a magnetic field, like any other conductor, and any magnetic field of the coil A will attract or repel the field of the electron beam, thus moving the beam itself.

THE PENCIL OF ELECTRONS

If we put an alternating current in coil A, the weightless beam will move back and forth vertically in unison with the coil frequency, as it has no inertia. This coil frequency is, say only 5 cycles per second. Then the beam will go back and forth across plate C five times a second or, in other words, will cross plate C ten times per second.

In the same way, and at the same time,

coil B is moving the beam horizontally, say 1,000 times a second, or across the plate C up and down 2,000 times in each second.

The distance moved horizontally or vertically depends only on the *strength* of the coil field, which may be changed by moving the coils towards or away from the tube, or by changing the current in the coils.

Now, with arrangements of the frequency stated, the beam will go up 100 times and down 100 times for each trip across plate C. If the distance across the plate is 8 inches, the beam will, in effect, draw 25 vertical lines on plate C for each inch of width. If the conductive portions are properly divided and positioned, the beam will hit each one of them once in this journey across the plate.

THE CIRCUIT

Suppose the beam strikes a conductive portion of the plate C which happens to be strongly illuminated by the rays of light falling through the screen S upon the other side of C. Then some of the electrons will travel along the ionized path of the light ray in the vapor, from that conductive section of C to the screen S; and a current will flow out around through the resistor R and back to the cathode F along the filament wires, the beam itself and the conductive path in the plate completing the circuit. The screen S may have a positive potential bias to aid this action.

The current which flows around this path is determined by the conductivity of the vapor path along the light ray between plate C and screen S at each conductive point. This, in turn, will depend on the intensity of the light ray at that point. Thus, as the electron beam sweeps over or "scans" plate C, there is created a varying current through resistor R depending on the intensity of the image at different points. This variation in current will cause a varying potential across resistance R and this is the potential applied to grid and filament of the amplifying tube. The condenser C1 permits the grid circuit of the tube to be adjusted to its best operating point. The output of the tube may be amplified and used to modulate a carrier wave. (See Fig. 1a for details of the circuit.)

THE PROJECTOR

Then, at the receiver, the amplifier output goes into the projector tube (See Fig. 2) which operates like any radio vacuum tube. The grid G is heavily biased negatively. Thus no electrons escape through the tubular opening in the plate P. When the varying signal impulses come through, however, this bias is counteracted and through the tubular opening passes an electron beam varying in intensity with the received signal.

Here again we have two coils at right angles, having the same frequencies as the coils of the camera tube and in phase with those frequencies. When the camera beam is at the top, the electron beam of the projector is at the top. When one is at the left, the other is at the left also. The relative position of the end of the projecting beam on the phosphorescent viewing screen of the projector is the same as that of the camera beam on the plate C in Fig. 1.

This viewing screen is phosphorescent and is swept or "scanned," just as plate C is scanned. When the electron beam strikes this phosphorescent screen, it "luminesces" or lights up at that point and the path of the beam on the screen becomes visible; the light and shade from instant to instant depending on the intensity of the beam. This instantaneous intensity is proportional to the received signal and, therefore, proportional to the intensity of the light and shade of the image points on plate C of the camera. Thus an image is projected, point by point and line by line, on the phosphorescent screen in the projector.

This image is readily visible in the partial darkness caused by the hood over the screen and may be larger or smaller than the original image; one way of changing the size being to move the phosphorescent screen in or out. The image may be applied to a film running through the vacuum tube by means well known in the oscillographic art; or it may be projected by prisms from the luminescent screen upon the wall of the room.

SPEED OF THE ELECTRONS

The electron beams may be moved at any speed and have been known to record a frequency as high as 220,000,000 cycles per second. Thus any speed of transmission is possible. Any sluggishness in the passage of the current through the vapor will have no effect on the image; as it will be uniform sluggishness all over the plate C. In fact, selenium may be used for the conductive portions of plate C (though not when potassium vapor is used) and thus an added variation in the current impulses produced by the effect of light and shade on plate C, will be obtained.

There are many incidental advantages in the apparatus which has been described but, in one particular, it gives rise to hopes that have never been dreamed of before; and that is, of a reproduction comparable to a "half-tone." In no other method is this even conceivable; for the reason that, while gradations of light and shade may be obtained, all of the dots reproduced are of the same size and shape. With the projector shown in this article, the reproducing beam varies in intensity, in number of electrons, *and thus in size,* under proper conditions. Intense beams will cause large dots and less intense beams small dots, and thus a gradation of the pictures may be expected.

Theoretically, this is the most perfect television device yet described. It has every element desired in such an apparatus. With every other apparatus we can immediately see definite limitations even on the theoretical side. With this we cannot. Whether its performance justifies its promise, I hope to report to the readers of RADIO NEWS in the very near future.

(EDITOR'S NOTE: *The theory and construction of the cathode-ray oscillograph was fully described in articles in* RADIO NEWS *for January and February,* 1926.)

Ground Often Unnecessary on Electrified Sets

WITH many radio receivers using "A" and "B" socket-power units, the usual conductive "ground" connection to the steam or water pipe can be dispensed with, in many cases. It seems that the capacity effect between the primary and secondary windings of the transformers in the "A" and "B" devices is sufficient to effectively "ground" the set through the house mains; one side of practically all house-lighting circuits being thoroughly grounded.

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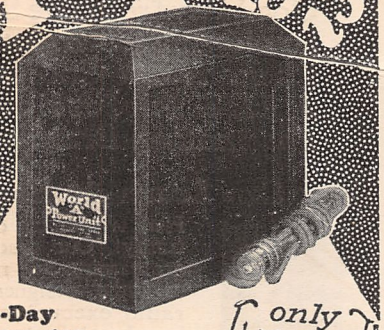

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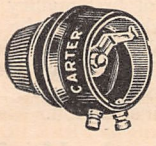

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RADIO PARTS SETS

Radio Aerials Create No Lightning Hazards

(*Continued from page* 31)

reader may be referred to "Harnessing Nature's Electricity," by Henry Townsend, in SCIENCE AND INVENTION for June, 1928—EDITOR.)

LABORATORY-MADE LIGHTNING

However, the radio engineer, like the radio listener, will be interested more in the effects of electrical storms than in their causes. It is known to all that the equalization of voltages, which is the function of the lightning stroke, takes place between two clouds, as well as between a cloud and the earth. The flashes of lightning between clouds are to be seen only when there is a difference of voltage between them—that is, when the process of condensation has gone on more rapidly in one than in the other.

When the lightning strikes the earth, however, it is of very practical interest to know how it will conduct itself. This question may be investigated experimentally on a small scale, with interesting results.

The writer has in his laboratory high-voltage apparatus, and has built for the purpose of his research into lightning the miniature "village," studded with lightning rods and aerials, which is illustrated here. The pictures accompanying this article show the discharges of artificial lightning, under conditions simulating on a small scale those occurring in nature.

Fig. A is a composite photograph, representing the path of many electric discharges, and illustrates the well-known fact that lightning does not follow the straight line which would be its shortest path, but takes a zigzag or wavy route which is determined by the resistance which it encounters at each instant of its progress. It will be seen that the majority of the discharges did *not* go to the highest point in the little group—the lightning rod on the church tower—but elsewhere in the field. The picture bears witness also to the truth of the old saying, that a lightning rod protects no further than a radius equal to its height.

In the path of the stroke, the conductivity of the air during the instant of discharge is the controlling factor, as we have said above. If a particular pathway in the air has an especially low resistance, the lightning will follow this to the earth. In Fig. A we see the series of discharges that strike to one side from the lightning rod and aerials; and Figs. B, C and D illustrate this point still further.

The miniature village and the artificial-lightning apparatus is pictured in Fig. E, and a map of the little village, showing the location of the lightning rods and aerials, is given for comparison in Fig. 2.

"FORKED" LIGHTNING

We have in the background the high-voltage apparatus and its switchboard; the highest voltage is produced at the point of the wire fastened to the upper end of the large coil which is extended over the table at an angle. The miniature houses are erected in a bed of moist sand, a little more than two feet below the end of this wire. The aerials and the lightning rod are grounded in this wet sand, which lies upon

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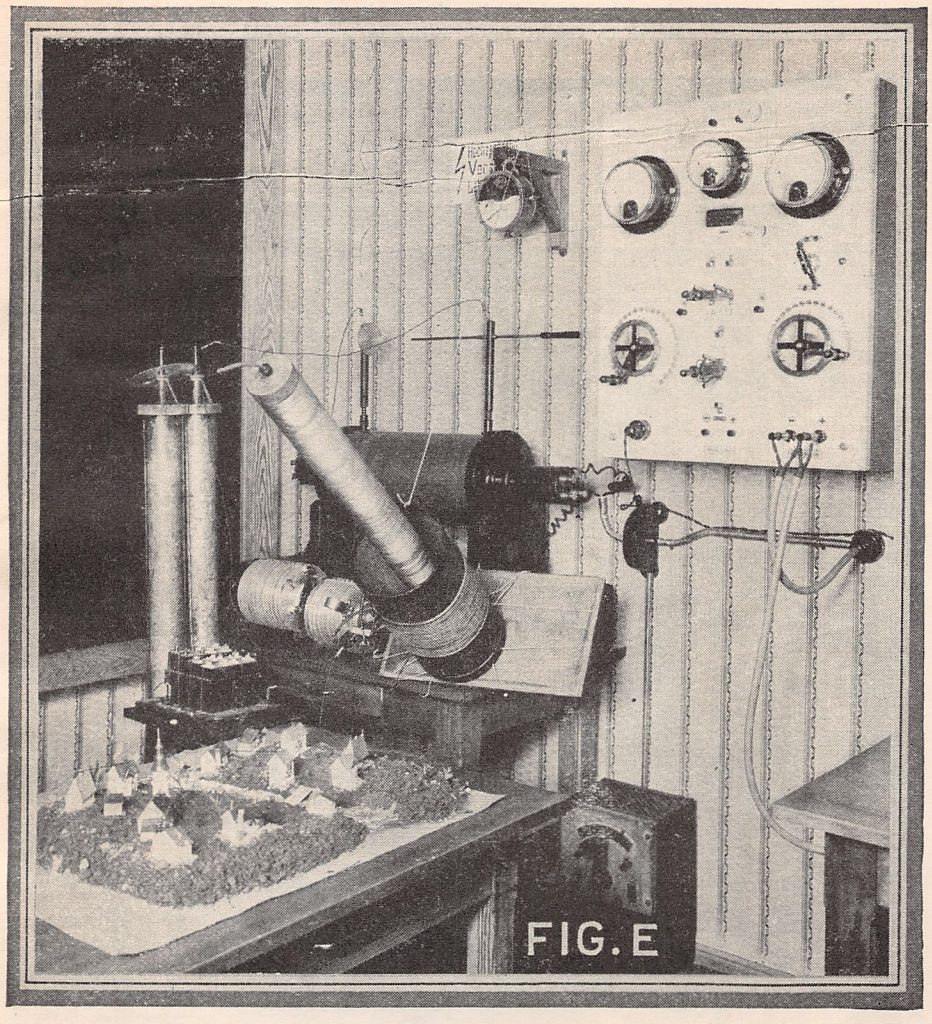
the metal plate which forms the other electrode of the high-voltage apparatus.

In Fig. B is shown a single discharge, in which the principal stroke was accompanied by several minor ones. It is necessary to imagine that, in addition to the path of the principal discharge, there are a number of others possessing more or less conductivity, through which lesser discharges



The high-voltage apparatus with which the miniature village was bombarded.

take place. In Fig. C the minor discharges are also plainly visible, the heaviest one falling on one of the aerials. In many cases it is not the principal flash, but one of the minor ones, which has fallen upon an aerial, when its owner reports a stroke of lightning. If the principal discharge has really fallen upon the aerial, it will generally be found that the wire has been turned into vapor instantly, so that there will be no trace of it remaining.

A typical case of concentration of the entire discharge will be found in Fig. D, where a very vivid stroke has fallen upon the lightning rod projecting above the church steeple.

CONCLUSIONS

The desirability of the use of lightning arrestors, to be installed where an aerial is led in to a building, is apparent, to avoid entrance of the high voltage of the lightning discharge, in the *very rare event that the principal stroke should fall upon the aerial.* In the case of such a direct stroke, the drop of voltage across the ground wire is accompanied by a current of great intensity, but infinitely short duration; but is so great that a considerable voltage may be induced in a receiver if it is still connected to the grounded aerial lead.

For this reason, it is recommended that the receiver be cut off from the lead-in at the point where it is grounded, during storms; or at least that it be placed some distance from this point.

The grounding of the aerial recommended by broadcasters is desirable, less to diminish the danger of direct lightning strokes, which are rare, but rather to diminish or prevent the setting up of internal voltages caused by minor strokes, or by inductive effects.

The production of voltages in this manner is more likely to occur—and far more so that of *voltages induced by a stroke on electric-light wires* than by a hit on the aerial by a direct bolt of heavy lightning. Where a bolt falls with full force, high voltages are produced for several hundred yards about, and all electric conductors are likely to be charged to a disagreeable extent.

To combat the formation of the induced potentials to which reference has been made, it is recommended that indoor aerials be grounded in the case of a storm. If the aerial is so grounded, and the operator avoids contact with it, there is no additional danger from its presence; but, on the contrary, through *the grounded aerial serving as a miniature lightning rod, the energy is led harmlessly away,* which would otherwise be felt in the vicinity of the aerial.

The aerial cannot attract lightning from any great distance; so that the improbability of lightning striking a house thus equipped is very great. This will be seen from the composite view in Fig. A.

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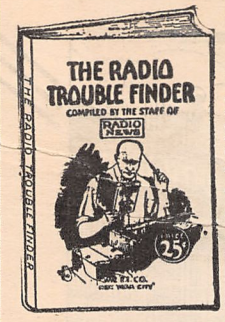

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Radio Behind Prison Walls

(*Continued from page* 11)

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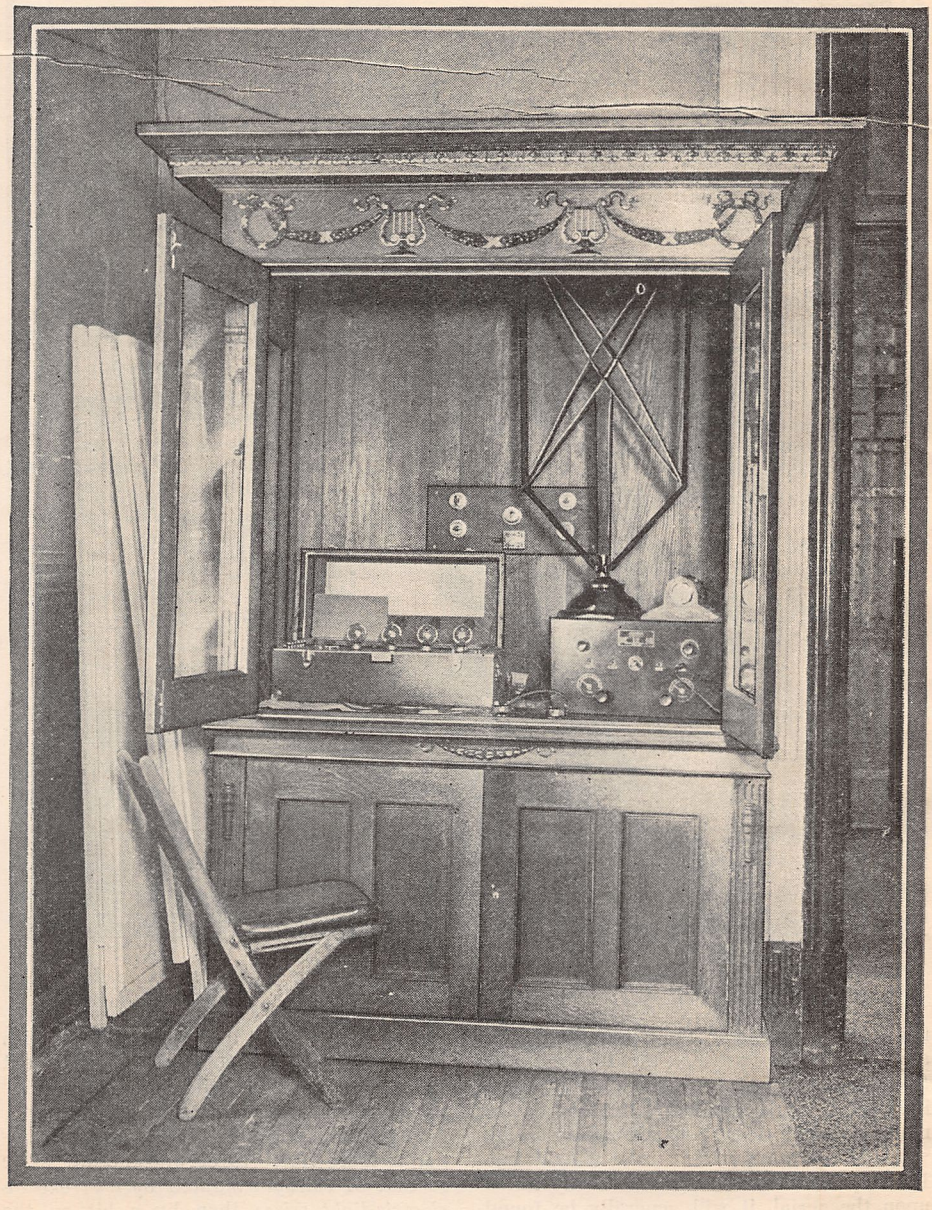


The central radio receiver of the New York State Prison at Ossining ("Sing Sing") with its power amplifier and distributing system, which actuates also a public-address system.

Obtaining Detector Voltage from a Home-Made Power Unit

WHEN constructing "B" socket-power units, many experimenters plan to obtain plate voltage for the operation of the detector tube by tapping the voltage-dividing resistor at the proper point. It is possible to obtain the correct plate voltage for the detector tube in this way, but often the A.C. hum is greatly increased. A more satisfactory method is to connect a grid-leak resistor, shunted by a by-pass condenser, between the plate circuit of the detector tube and the terminal of maximum plate voltage in the power pack. By this system an additional resistance-filter stage is provided, which greatly improves the current delivered to the plate circuit of the detector tube. The resistance of the grid leak required is determined by the maximum plate voltage of the power unit; however, the correct value is usually 500,000 ohms when using a power unit with an output of 400 volts. A modern type of resistor, capable of dissipating 10 watts, should be used.

Interstage Coupling for Screen-Grid Tubes

(*Continued from page* 51)

ANOTHER DESIGN

A circuit that will give somewhat higher amplification per stage than the one previously described differs only in the design of the interstage coupling device and in the selectivity obtained; this is shown in Fig. 2. The circuit as a whole is similar to that shown in Fig. 1, the coupling circuit in Fig. 2 replacing the choke coil L1 in Fig. 1.

The principal difference between this circuit and that previously described is the smaller inductance-to-capacity ratio, which results in a comparatively sharply tuned circuit in each stage. This eliminates the necessity of a sharply-tuned input transformer to obtain the desired selectivity. With two stages of screen-grid tubes, this circuit will be sufficiently selective to meet the present broadcast conditions; but not so much so as to cause distortion.

The inductance used in this circuit is a self-supporting-form winding of the "Universal" type, with 600 turns of No. 20-38 Litz wire; it is important to *keep the losses low*. The inside coil diameter is 5/8-inch; width of winding is also 5/8-inch. This gives an inductance of slightly over eight millihenries. A somewhat smaller coil is made with solid wire; these would be extremely difficult to wind evenly by hand, but can readily be purchased for a small amount.

For coupling from the first detector tube, a 201A-type, the values given above will not permit the 201A-type to be worked very efficiently as a detector. It was found that a decrease of inductance, and a corresponding increase of capacity, greatly improved the operation of the first detector. In the final circuit the first detector was worked into a circuit having an inductance of 2 millihenries and a capacity of .001-microfarad. The same type of winding is used but, in order to obtain one-fourth the inductance, only *half as many turns are used; i. e.,* 300 turns instead of 600.

TUNED COUPLING TRANSFORMER

When the broadly-peaked circuits are used in the intermediate stages, a tuned input transformer is necessary in order to obtain the desired selectivity.

This tuned transformer consists of two "Universal" wound coils having the dimensions given above; *i. e.,* 600 turns of No. 20 wire, an inside diameter of 5/8-inch and a width of 5/8-inch. These should be mounted with their planes parallel and spaced about one and one-quarter inches apart, as shown in Fig. 3. Each coil should have connected across it a low-loss fixed condenser whose capacity is .00025-microfarad. The resonant frequency of this combination will be approximately 137 kilocycles.

The use of the chokes above mentioned (No. 85) and the tuned input transformer makes a simple circuit that will give excellent results; good amplification, good reproduction and sufficient selectivity.

If higher amplification is desired, in order to operate this receiver on a small loop, a third intermediate stage of amplification may be used. It must be remembered, however that, if this is done, still more care must be taken to see that the shielding is as nearly perfect as possible.

Similar results may be obtained by using a good bandpass filter instead of the tuned input transformer. For the experimenter the tuned transformer is probably the more practical; although there are several bandpass filters on the market at present that may be used.

The experimenter will find that the degree of success he obtains with this circuit will depend directly upon two factors, *low loss* and *good shielding.*

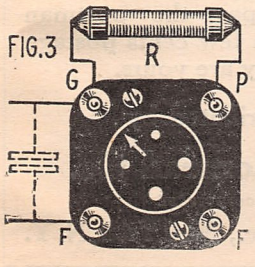
Obtaining Suitable Screen-Grid Voltage

(*Continued from page* 51)

and plate current show that the screen current will be approximately 0.18-milliampere, with a plate voltage of 135 and a screen voltage of 45. Assuming that these are the values we are to use in the circuit, it is evident that the series resistor must be of such size that the voltage drop across it, due to the screen current, will be sufficient to reduce 135 volts to 45 volts. In other words, the drop across this resistor must be 135 minus 45, or 90 volts.

Then, applying Ohm's law:

$$R = \frac{E}{I} = \frac{90}{.00018} = 500{,}000 \text{ ohms.}$$



This simple connection puts a suitable high resistor—500,000-*ohm*—*between the screen-grid and the plate of a 222-type tube, as shown in Fig. 2 on page* 51. *A suitable proportion between the voltages on these elements is thus obtained.*

Since this can be supplied by a standard size of metallized resistor, capable of carrying safely far more than .018-milliampere, see how simple our problem has become. It is possible, in most cases, simply to connect this resistor between the plate and screen-grid posts of the tube socket, as shown in Figs. 2 and 3; although, theoretically, it would appear that the arrangement of Fig. 1 is better. This, perhaps, is a question whose answer depends on the remainder of the circuit and the voltages used.

The shielding system of the receiver, usually, forms the negative filament return and, where this is the case, it is customary to simply ground the screen-grid by-pass condenser to this shielding system. However, care must be taken to *make all ground connections at the same point on the shield.* If this is not done, circulating currents will be set up in the shield and undesired coupling effects will almost certainly result.

It will, of course, be evident that this same arrangement may be used to obtain the *positive bias for the inner grid,* in any space-charge-grid A.F. amplifiers.

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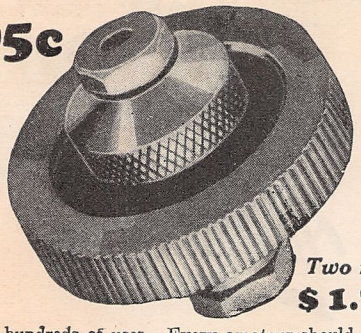

Two for $1.75

Have hundreds of uses. Every amateur should have two or three of these amplifiers in his laboratory.

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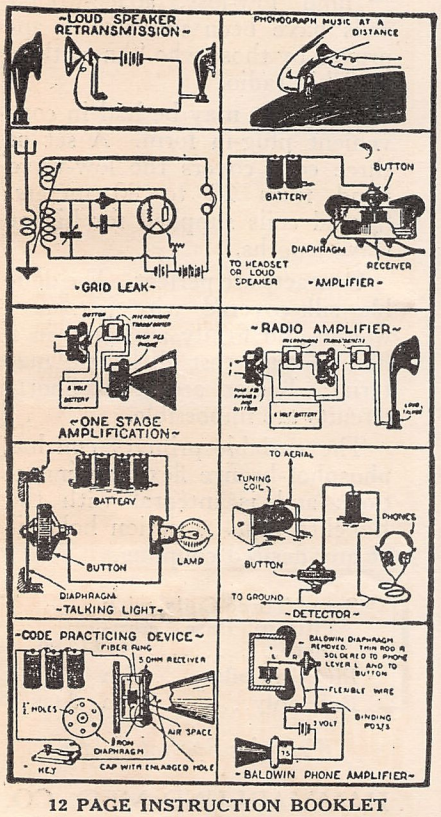

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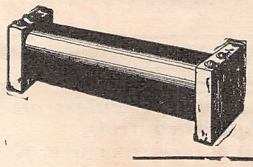

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Radio Aerials

(*Continued from page 27*)

the aerial, it is an essential part of every antenna system and for this reason will be considered in this article. The electrical function of the ground has been considered in the first part of this article, and, therefore, only the practical side of the ground installation need be discussed here.

It is the object of the ground wire to provide a connection to the earth of as low a resistance as possible and, usually, this may be accomplished most easily by connecting the wire with a cold-water pipe. Water-pipe grounds are approved by the Fire Underwriters, and they are far more efficient than the usual artificial or home-made ground connection. Connection is made to the cold-water pipe by a device known as a *ground clamp*. The ground clamp is a strip of sheet brass or copper, about one inch wide, which is fastened to the water pipe. However, before the clamp is applied, the outside of the pipe should be thoroughly cleaned in order to insure a low-resistance connection. In places where a city water pipe is not available, a radiator pipe may be used; but the *gas pipe must not be employed for this purpose.* Often, improved results may be obtained by using both radiator and cold-water-pipe ground connections.

On a farm in the country, where such a convenient ground is not available, it is sometimes necessary to make a special ground connection. For this purpose a metal object with a large surface, such as a clothes boiler, should be connected to the ground wire and buried about three or four feet deep in the ground. This should be located in a place where the ground is damp at all times and, before the hole is filled up, it is necessary to make sure that a good electrical connection has been made to the object which is used as the ground. The wire from the receiver to the ground may be No. 14 copper wire.

LIGHTNING ARRESTOR

The last, but one of the most important things to consider when erecting an aerial is the lightning arrestor. This piece of apparatus is required by the Fire Underwriters' regulations, and it is connected between the aerial lead-in and the ground, near the point where the lead-in enters the house. It may be located on either the outside or inside of the building.

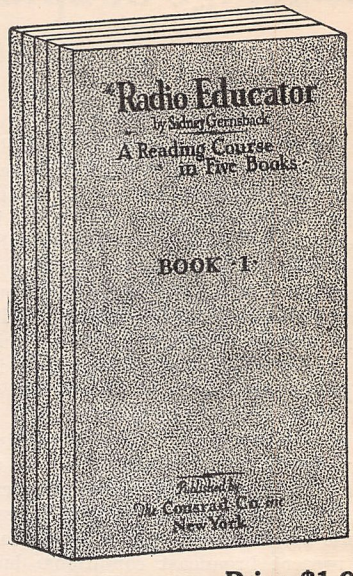
As the lightning arrestor has nothing to do with the operation of the receiver it is not necessary to discuss its electrical features in this article. The radio fan who buys a lightning arrestor should first make sure that it has been approved by the Fire Underwriters; and, if so, he may feel perfectly safe in using it according to the directions given by the manufacturers for its installation.

HOW TO BEAT THE RACES

(Broadcasts from Australia are heard in England ten hours earlier in the same day. This bit of radio relativity inspires the following ingenious suggestion from an English radio and racing fan.)

We've just heard a good relay
Of Sydney (2FC);
As their time's ahead, I wish they'd say,
Who'll win the 3:33.

—Arthur Wolfendale.



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Radio Wrinkles

(*Continued from page 47*)

the resistor, which is mounted on the condenser shaft is varied in resistance, proportionately to the capacity of the condenser. When the condenser is set at minimum, the entire resistance is in the circuit and, at its maximum capacity, the resistor is entirely short-circuited.

The value of a device of this kind may be appreciated better when it is known that the average receiver is much more efficient on the short wavelengths than it is on the higher wavelengths. Because of the increased efficiency on short waves, one of two conditions usually exists; either the operation of the receiver is unstable, and there is a tendency for the R.F. stages to oscillate on the short waves, or the receiver is inefficient on high wavelengths and reception is comparatively poor.

It is the purpose of a device of the type described here to increase the stability of the receiver automatically as the wavelength of the set is decreased. This is accomplished by introducing resistance into some part of the circuit. Therefore, with a receiver using this type of unit, the circuits may be adjusted so that maximum efficiency is obtained on the high waves; and then, as the wavelength of the set is reduced, the resistance introduced into the circuit will be sufficient to prevent the R.F. circuits from becoming unstable.

There are a number of ways in which this unit may be connected, but in each case a different value of resistance is required. If it is so desired, the unit may be employed to introduce resistance into the filament circuit of the R.F. tubes and, in this case, a resistor unit having a low resistance value is used. Secondly, it may be used to vary the value of the grid bias on the R.F. tubes and, for this purpose, a resistor unit of intermediate value would be needed. Thirdly, it may be used to introduce resistance into the plate circuit of the R.F. tubes, and a high-resistance unit will be required in this case.

It is impossible to give complete directions for building a unit of this type, as each make of variable condenser will present a slightly different problem to the constructor. However, the drawing shows the method used by the writer, and a somewhat similar arrangement may be used for other makes of condensers.

In order to adopt the resistor unit to the variable condenser illustrated, it was necessary to remove six plates (three stationary and three rotor) from the rear of the condenser to make room for the resistor unit. The resistor unit was made from the resistor strip of an old rheostat and mounted on the rear of the condenser shaft. Below the resistor unit, a pulley having a diameter equal to that of the resistor unit was mounted on the condenser frame, in such a way that it would rotate with the condenser shaft.

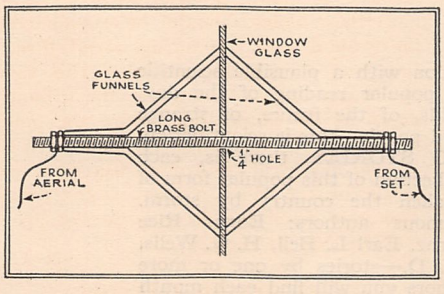
Next, a flexible wire and a rubber band were required. The wire is used to short-circuit the resistance wire, and the rubber band is employed to keep the wire tight and to turn the pulley. The wire and rubber band are both fastened to the resistance unit, at the point where the winding starts, with the machine screw which serves also as a terminal of the resistor. Both the wire and rubber band are also attached to the pulley in much the same manner. An examination of the illustration shows how the resistor operates. As the condenser shaft is turned, the resistor turns and the pulley is turned by the rubber band. The turning of the resistor unit causes more and more of the resistance wire to be short-circuited by the flexible wire.

The arrangement illustrated in the picture may be varied and simplified in many ways. In the case of condensers which have a removable shaft, the resistor unit may be mounted on the rear of the condenser, thus simplifying the construction and avoiding the necessity of removing plates from the condenser. Also, with this system, a slider contact may be used, thus making possible the construction of a potentiometer.

A Highly-Insulated Lead-In

AN efficient lead-in insulator can be constructed from two glass funnels, such as are used in laboratory experiments. These can be purchased at most drug stores and, together with a long brass rod threaded at each end, four brass nuts to fit the rod, and two small rubber washers such as plumbers use, complete the material needed to assemble the insulator. The completed device is shown in the diagram.

A hole, slightly larger than the brass rod, is made in the wall or window through which it is desired to bring the lead-in; and after one of the funnels has been placed



A method of using two glass funnels as a lead-in insulator. The threaded brass rod which clamps the funnels in place serves also as part of the lead-in wire.

on each side as shown, the rod is passed through them and one of the rubber washers is placed on either end, followed by a nut which should be screwed firmly in place. A second nut is then placed on each end of the rod, for the purpose of holding the connecting wire in place.

In order to install the insulator on the window it will be necessary to drill through the glass pane a hole slightly larger than the rod. This can be done with a small rat-tail file and a little turpentine. The file should be placed in a small hand-drill and the end of the file broken off with a pair of pliers. This leaves a sharp, ragged edge which should be placed firmly against the glass and turned slowly. At the same time the surface is kept wet with the turpentine. Care should be taken not to apply too much pressure to the drill, and to see that the glass pane is laid on a perfectly smooth, firm surface.

This insulator is satisfactory for either transmitting or receiving aerials; the same plan of construction may be followed when it is desired to pass the lead-in wire through the wall of a building.—*M. M. Dohmlo.*

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SEND NO MONEY. Pay postman $4.95 plus postage for a HOME BROADCASTER OUTFIT, consisting of Microphone, Special extension cord and adaptor plug. State whether Set Uses 4 or 5 Prong Detector Tubes. Money back guaranteed. Elba Products Mfg. Co., 726 Atlantic Avenue, Brooklyn, N. Y. Dept. 226

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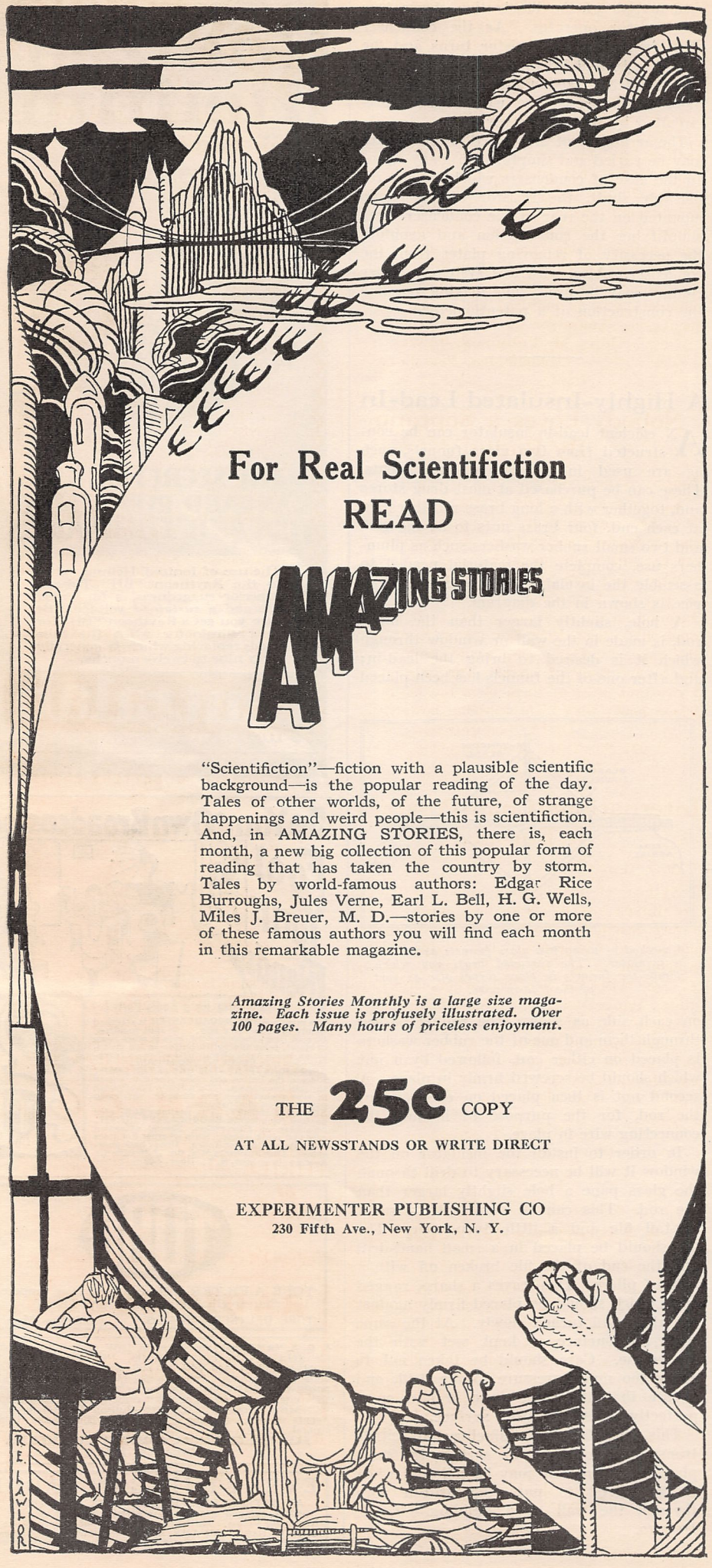
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R. E. LAWLOR

Television Demonstrations Through WRNY

(*Continued from page 21*)

after it has undergone thorough tests both in the laboratory and in practical service.

OPERATION

The television transmitter is made mostly of wood, and stands about five feet high, three feet wide, and about four feet deep. The legs are fitted with casters, so that the whole machine may readily be moved from place to place. As a subject prepares to be "televised," he or she merely sits down in front of the "illuminator," shown on page 20. It is a square box fitted with twelve 50-watt lamps and a highly-polished reflector. Directly behind an opening about six inches square in the latter is a very "fast" lens (f. 1.5) which concentrates the image of the subject on the revolving disc behind it, which is pictured separately at the lower right. The disc's driving motor, which is not shown, will be placed on the baseboard in the immediate foreground.

Behind the perforated disc is a small box containing a photo-electric cell and a three-tube amplifier. As the disc revolves and allows the reflected light from the subject's face to pass through the small holes, one at a time, into the cell, the latter translates the light impulses into electrical impulses, which are led to the broadcast transmitter. (A close-up of the photo-electric cell unit appears in the panel above; the cell is the large round bulb at the left; the square opening in the steel can allows the light rays to affect the cell in the proper manner.)

In his next article, the writer will discuss his television transmitter, the amplifier and the exact method of putting the images "on the air."

(*On the very closing day of this number of* Radio News, *an announcement was made by the General Electric Company that station WGY, transmitting on its regular* 380-*meter wave, would commence broadcasting television programs on a regular schedule. The pictures will be sent from the WGY laboratories in Schenectady, N. Y., on Tuesday, Thursday and Friday each week, between* 1.30 *and* 2.00 *p. m., Eastern Standard Time.*

Only the faces of men talking, laughing or smoking will be broadcast, the announcement said; no elaborate effects are planned at this early stage.

The regular schedule of transmission is designed primarily to assist engineers in the development of a reliable and complete television system; but, since the signals may be picked up with ordinary broadcast receivers, amateur experiments may readily use them for the testing of television apparatus of their own construction.

As heard from the loud speaker, the television signals have an intermittent, high-pitched whirr; the pitch varying with the action before the transmitter. This description is contained in the announcement.

The television transmitting apparatus is a modification of the Alexanderson machine described in the April, 1928 *number of* Radio News. *No information on the construction of receivers suitable for the reproduction of the broadcast images was available at the time this number of* Radio News *closed; but, as soon as the data can be presented in useful form,* Radio News *will publish them.*—Editor.

The Listener Speaks

(*Continued from page* 18)

remainder of the Dominion, the whole of it, goes to maintain the federal radio department. Thus, the people who use the radio pay for its regulation. The Dominion government maintains in most of the large cities interference cars to locate noises which interfere with reception, and I believe they are doing good work. This also is paid for out of the dollar license fee. It will take a lot to convince me that Manitoba is not as near a radio paradise as can be found on the North American continent.

W. C. Tremlett,
Suite 1, Carlyle Apts., Broadway,
Winnipeg, Manitoba, Canada.

Business is Business

Editor, Radio News:

I have on file copies of this magazine dating back to January, 1920. If Mr. D. V. Chambers has been a reader as far back as that, he should know something about code, as Radio News was the operator's bible in those days before broadcasting became so popular. If he knew half as much as he claims, he would realize that 99.9% of commercial broadcast is strictly business, and of more importance than the broadcasting of programs of music, prize fights, and so forth. Even if he is bothered by commercial code work, why should he blame the poor operators? They are not responsible for the sometimes-antique transmitting outfits which they have to use. Rather lay the blame at the doors of the owners who supplied the apparatus and do not care to replace it with modern equipment.

Of course, the change in Radio News which J. E. Kitchin mentioned has been very noticeable; but the average radio bugs care more for a combination joke book, movie magazine and so forth than they would for a purely technical radio magazine. I have also noticed the entries in the "wrinkles" contest; they are, many of them, ideas which have been in use for years but are necessary for the beginner.

I base my opinions on observation, as both an operator and an occasional B. C. L., and not on what so-called experts say or think. In my opinion, Mr. Chambers had better know what he is talking about; for it amounts to either foolishness or superlative imagination to say that "the N. B. C. has the crust to ask us to pay $3 to $20 a year." This alone should be enough to show what a foundation he is building his biased arguments on. Yours for the best in radio.

John M. Thompson, 8AWG,
Canandaigua, New York.

Nobody Loves a Soprano (By Radio)

Editor, Radio News:

Kindly keep the girls off the front cover. It is bad enough to listen to sopranos over the air without seeing them on the cover of my favorite radio magazine.

Why don't you put pictures of Marconi, de Forest, Armstrong, Edison, Hertz and Fleming on the front cover? If the B. C. L.s don't like them, they can throw them into the ashcan. These men made radio; but where are their pictures? The only place I can find most of them is in the N. R. I. lesson books that I am studying now.

D. D. Bartholomew,
221 So. Third Ave., Bozeman, Mont.

International Chain Program in Europe

Editor, Radio News:

At last, Germany, Belgium and England are linked up by land line, and it was rather fascinating to hear the German announcer at Cologne say last night, at the conclusion of an act of *The Marriage of Figaro,* "Hier die Sender Aachen, Münster, Köln, Langenberg, der Deutschlandsender Königswusterhausen, und die Sender Daventry, London und Brüssel"—rather a mouthful for the first such stunt. Wait till Stamboul, Paris and Budapest, etc., are all linked up. The whole "do" was quite successful.

E. T. Somerset,
Inholmes Park, Burgess Hill,
Sussex, England.

A Listener's Directory

Editor, Radio News:

Mr. Woodruff comments on Chicago announcers "dedicating" selections to "So-and-So" at Kansas City during daylight hours, when, as he says: "I am sure that there was not a ghost of a chance that the lady heard even the carrier wave."

Now, I am not a fabulous DX hound, but I receive stations WGN, and KYW and its sister station KFXF daily during daylight hours, with a good loud-speaker volume. It is now 11 a. m., January 27, with the sun brightly shining, and I have just had WGN, KFXF, and WMAC, with good volume.

AMAZING STORIES — IN OUR JULY ISSUE

Vandals from the Moon, by Marius. The steamship imitates the fish in its manner of locomotion, the airplane imitates the bird; but no engineer seems ever to have thought of duplicating the snake's motion for propelling heavy bodies. Yet it is perfectly plausible, and the author of this story may prove to be a prophet some day. It is certainly an interesting and original idea and furnishes excellent material in a unique interplanetary tale, this time dealing with the moon people who visit our planet.

The Invisible Man, by H. G. Wells. Part II. In the concluding chapters of this story, the harassed and harassing invisible man finally reaches an old scientist friend of his, to whom he relates his experiments, his unexpected success and his subsequent experiences. But you don't need to be a dyed-in-the-wool scientist to become thoroughly absorbed in the story of their subsequent experiences.

Baron Münchhausen's Scientific Adventures, by Hugo Gernsback. (Conclusion). What will our descendants do ages from now, when their air supply dwindles down to nothing? According to our very remarkable friend, the Baron, the Martians have already solved this problem by their marvelous invention of air plants, with which they generate their own air. The Baron tells us also, how the Martian canals were built, and, lest we think them always serious and scientific, we are permitted a glimpse into their lighter moments.

Just Around the Corner, by Raymond Knight. We offer this interesting playlet, which in a sense is based on science, as a novelty to our readers.

And others.

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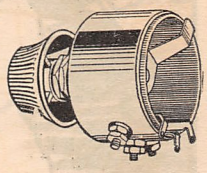
Positive Voltage Control for Radio Power Units

The new **Centralab Heavy-Duty Potentiometer** is all wire wound and will carry the entire output of any "B" power device with an unusually high margin of safety.



Resistance remains constant at any knob setting, so that panel or knob can be marked in volts. A single turn of the knob will give full variation.

Has sufficient current carrying capacity to permit shunting a low resistance value across the "B" power unit to obtain constant voltage regulation. A sufficient current load is maintained throughout the resistances to reduce the rectifier voltage to workable pressure, even though set is not connected—an insurance against filter condenser breakdown.

Write for folder giving details of this circuit.

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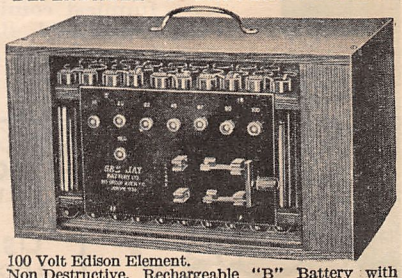

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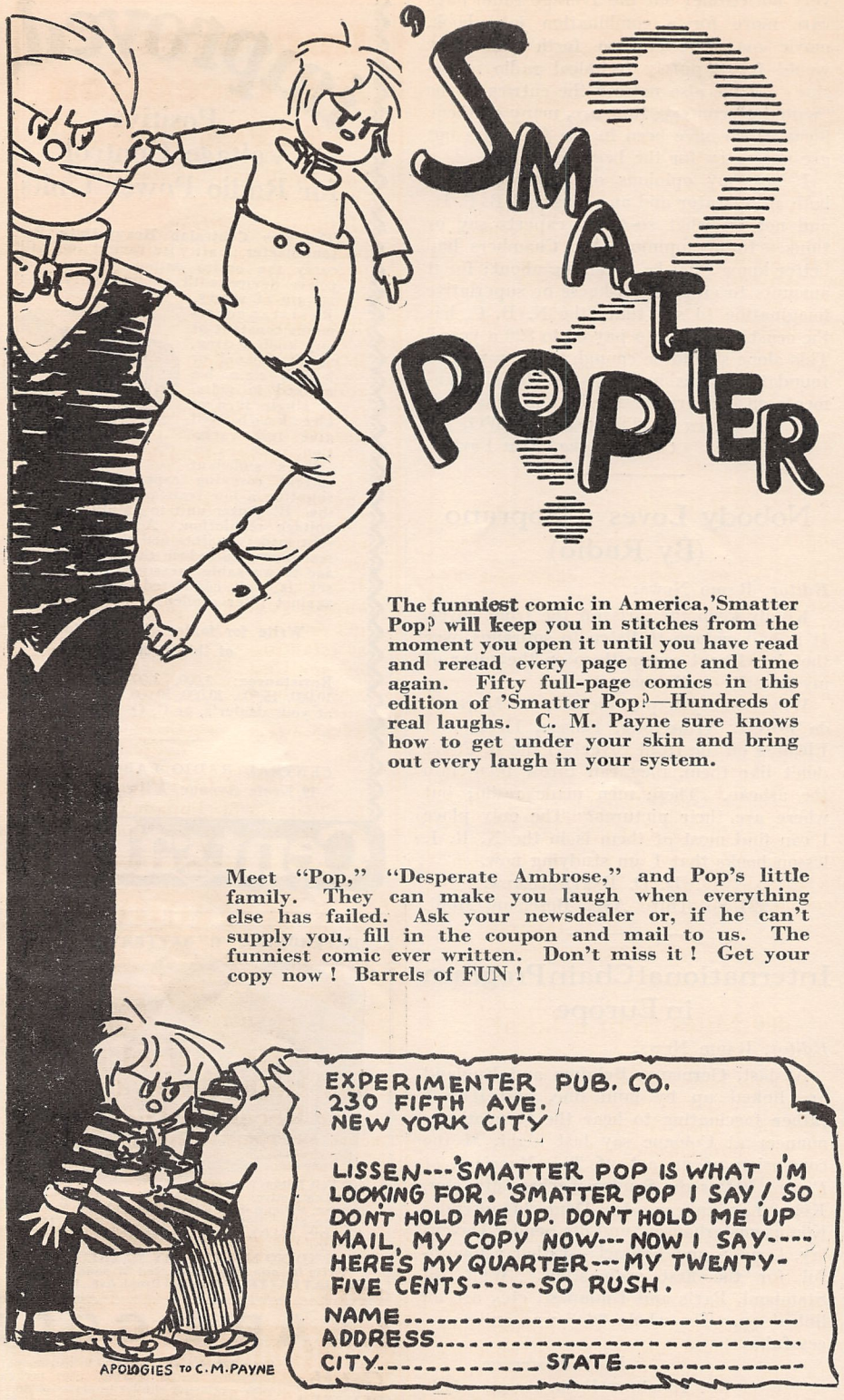
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Recently, I brought in WLW, WSAI, WJR, WWJ, WJZ, and WEAF in the afternoon, at 4 o'clock, when the sun was shining here. Since then, I have had WJZ during the afternoon. KMOX, 200, and Davenport, 275 miles, are regular daylight features, as are some twenty other stations within a 200-mile radius.

I have a combination set, which consists of a "Penetrola" as first R.F. stage. Then a six-tube Atwater Kent, No. 30. Last I have a power unit, 180 volts, making eight tubes in all. I have an underground antenna running into the Penetrola. Between the Penetrola (first stage) and the A.K. (second stage) I have inserted a light-socket antenna, through an adjustable condenser.

It is only since I introduced the second antenna that I have succeeded in obtaining the daylight DX, and I cannot do it without it. What has occurred, I don't know; I accidentally stumbled on the hook-up.

W. H. Heyser,
3340 *Montgall Ave.*,
Kansas City, Mo.

Where It Comes From

Editor, Radio News:

I am sending you a solution to some of the mysteries; I have read of an experimenter who can bring in music without aerial, speaker or phones, but who cannot explain it. I can go him one better; any set using an output filter to protect the windings of the speaker will do the same.

You can remove the diaphragm from the phones, and hear the music in them. They have a winding with an iron core—and so has the output choke. If a diaphragm were attached to the choke, you would have volume as from your speaker.

I have also received telephone messages from my radio and loud speaker, and spent two days figuring it out. If anyone would like to have the solution, I will give it on request.

Wm. J. Brooks,
112 Warren Ave., Milwaukee, Wis.

(*The composite nature of the core of the filter choke—very thin insulated sheets—will magnify this effect if they are in the slightest degree loose. For a like reason, 60-cycle hum may often be heard from a transformer. Suitable mechanical clamping of the core will very largely overcome this. The choke is not meant, however, to be a rival of the loud speaker, but by its high impedance to drive as much as possible of the music back into the loud speaker. A similar letter has been received also from Mr. J. Millman, of Denver, Colo.* —Editor.)

Return Card Attached

Editor, Radio News:

I wish to take exception to Mr. Duncan's complaint in March Radio News, that he gets no answer to his letters sent to broadcast stations. I do not think this is fair to the stations, as I have written to 78 of them and have received to date 72 answers. Perhaps it is because I have always enclosed a two-cent stamp for a reply. I realize that stations receive thousands of letters each day, and for them to answer each one and pay the postage would be prohibitive. I think I have proved

my point that the stations will more than meet your request for verification if you will enclose the postage.

J. M. Dillon,
412 No. 18 St., Richmond, Ind.

Editor, Radio News:

I am enclosing a list of stations that I logged between January 21st and February 21st, and you can see what results I had. There is a total of 216 stations; and I got my card or a stamp from 199 of them—which is, I think, very good.

I used a double (stamped) post card with my address on the return card. I received 165 of my cards back, 27 letters, 4 stamps—and three wanted a dime before they would send a verification. I think everyone would have better luck if they enclosed a return stamped envelope or card, self-addressed, with each communication.

R. H. Summers,
54 Fairwood Ave., Pleasant Ridge, Mich.

(Of the 17 stations from which Mr. Summers failed to receive replies, about half were Canadian—to whom the postage sent was useless. The reply cards which are good within the United States cost only two cents—one cent each way—at any post-office, and make things much easier for the stations. To the correspondent of only ordinary activity, it would come as a surprise to be in any office where hundreds and thousands of letters are received daily; and bring a better appreciation of the task which would be involved in answering them. Radio News *receives an enormous number of letters daily; and, interesting though many of them are, several times the present staff would be required to answer all of them at length and chattily, as we would like to do.*—Editor.)

What a Listener Hears

Editor, Radio News:

Having read, with interest, reports from your readers on daylight reception, I decided this morning to tune in a few and set up a mark for the boys to shoot at.

I am something of an old-timer in the game, having had my first set, a three-tuber, the winter of 1922. I now use a Bremer-Tully six-tube Counterphase, 110 feet of antenna, including lead-in. I am showing Mountain Standard time. Everything out here is DX, and I am giving proof of reception by mentioning something from each station. I picked up various other stations but they refused to identify themselves and I had only a limited amount of time.

Practically all the stations I am listing are a thousand or more miles distant, several being round twelve hundred, and Fort Worth, I believe, about fifteen hundred miles distant. The volume by no means enough to jar the rafters, but about equal to conversation. I get no particular kick out of daytime reception unless it is something very special, because the signals being naturally very weak must be highly amplified and, in doing this, the local noises, static, etc., come in about as loud as the broadcasting. I use a 201A detector.

(Mountain Standard Time)

7:55 A. M.—WHO, Des Moines. Orchestra playing "We."

8:00 A. M.—KMTR, Hollywood. Setting-up exercises.

8:04 A. M.—WBAP, Ft. Worth. Announcing cotton market 8 to 10 points higher; New Orleans market closed account Mardi Gras celebration.

8:06 A. M.—KFRC, San Francisco. Frank Black and orchestra playing "Ricket Rackety Shack," and "Together We Two."

8:10 A. M.—KPO, San Francisco. Wilhelm Cox playing on the pipe organ, followed by "second class in exercises."

8:17—KMA, Shenandoah. Giving a recipe on "How to make a Hawaiian pie."

8:20 A. M.—KNX. Exercises.

8:26 A. M.—KSL, Salt Lake. Staging a dog fight with WNAX (same wavelength and power), but manage to distinguish KSL singing "Sweet Rosie O'Grady."

8:28 A. M.—KTAB, Oakland. Lady singing, followed by a talk on healthful breathing.

8:38—KMBC, Kansas City. Playing old-time stuff, including "Casey Jones," followed by wild jazz.

8:43 A. M.—KFWI, Frisco. Man telling us where to take an old felt hat and for three dollars have it made into a fine hat; also a talk on Edgeworth tobacco, how to get a free package cigarettes, etc.

8:50 A. M.—KFYR, Bismarck. Hawaiian music, followed by lady singing "Home Sweet Home."

8:55 A. M.—Des Moines. Back to WHO again; this time a man telling us how to make a steamed cherry pudding.

At 11:35 A. M. I sneaked away for ten minutes and got:

WHO, Des Moines. Orchestra playing "Sunrise."

KGW, Portland. Piano and violin playing "O Solo Mio."

KFNF, Shenandoah. Henry selling the farmers clover seed and telling them about seed inoculation.

WCCO, Minneapolis. Man telling us about mail received from many states and reading a letter from a listener in Montana.

KOA, Denver. Giving us weather and market reports.

I find that, after about three o'clock p. m., in winter time, stations come in good quite often. I can almost always pick up a few stations, during the middle of the day, a thousand miles distant but too much amplified noise to make the stuff worth listening to. All right, now, "you" are next, and come on with your proof.

B. C. Hazlett,
Box 379, Livingston, Montana.

---

400 Miles from a Local

Editor, Radio News:

Anent the much-talked-about daylight reception of broadcast programs, I would like to put in a word or two. A glance at a map will show anyone that, here in Kirkland Lake, *we are more than four hundred miles from our "local" stations;* and yet we receive all kinds of broadcast programs throughout the day.

Beginning with the time we get up, I have listened in to four different stations broadcasting setting-up exercises. I have frequently listened to WCCO broadcasting phonograph music, for as much as two hours at a time. We have had beauty hints from a station in Toronto at 11:00 a. m. We have often set our clocks by WLS or KYW at 1:00 E.S.T. WOC often comes in fairly loud in daylight. WLW and WEAF have frequently been heard in mid-afternoon. All this has been with a Sparton 6-tube tuned-radio-frequency receiver, with a sixty-foot, two-wire "T" antenna; and a poor (comparatively) ground connection. There is very little earth here soft enough to put in a good ground; it is all solid rock.

Just by the way, this same receiver has broken every local record for distance. KFI has been received with a volume of about R5. Our list includes WBAP, KGW, WSB, KFRC, KFSD, CFCN, KRLD, KPO, KWKH, CKY, KHQ, KVOO, KJR, KOA, CKCK, KOMO, WIOD, and several dozen of others. I have picked up WBAP and KOA within an hour after sunset. The former was picked up while WEAF was

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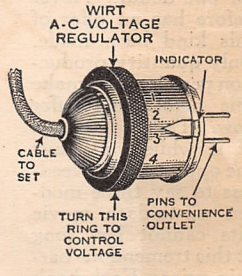

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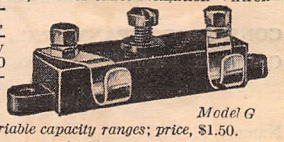

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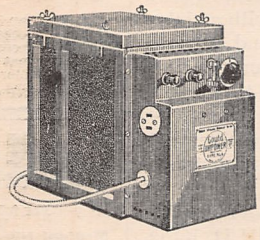
Fundamentally different from any other automatic charging "A" power device on the market. Its Kathanode construction insures longer life and is an exclusive patented feature, being used by the U. S. Government in their submarine batteries which are furnished by Gould. Its high capacity makes its especially adaptable to heavily worked or power tube sets.



Equipped with a noiseless Balkite Charging Unit, which has four graduated charging rates, and in addition one booster rate (1½ amps.), which always keeps the battery fully charged.

Operates on 110-120 volt, 60 cycle A. C.

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broadcasting; the latter was not interfered with by either KDKA or WBZ. So much for selectivity, is merely an appetizer. Here's some more—I find it easy to listen in to either WIP or WLS without interference from the other. I have also been able to enjoy the evening chime program from WOC while WGY was going strong. I have found, though, that it is almost impossible to get WIOD while WOK or WMBB is on the air; they also prevent me from hearing KTNT and they even heterodyne with WFIW.

I don't think that there is another set retailing for less than $150 ($200 in Canada) that can duplicate this record from this location. There are about ten other makes of radio sets used and sold here, including a couple of superhets, and they all have to admit that a 1-dial, 6-tube Sparton can run rings around them. Guess what kind of radio I'm agent for!!

Thank you, Mr. Editor, for an audience. I like RADIO NEWS; and think it is the best magazine in its field.

THOMAS C. RUMNEY,
Kirkland Lake, Ontario (Canada).

Sun-Maid Reception

Editor, RADIO NEWS:

Having read Mr. Woodruff's article in the February RADIO NEWS issue and his doubts about distant daylight reception, I wish to give my experience with a three-tube set I just recently constructed from an old copy of RADIO NEWS, December 1926. (The Universal All-Circuit Set, by Joseph Riley.)

While writing this letter I am listening to a Columbia Orthophonic concert from Salt Lake City, Utah. They just finished playing *"Cavalleria Rusticana"* and *"Laughing Charlie."* It is now 4:30 P. M. and the sun is shining bright in Fresno, California.

At night I play WBBM at Chicago, KOA, Denver, WCCO, Minn., CNRV, British Columbia. One night I picked up WFIW, Hopkinsville, Ky. The set has very little body capacity for a blooper and by careful handling I can operate it all evening without making it squeal.

G. E. GRAY,
2939 *El Monte Way,*
Fresno, California.

Under Heavy Fire, But Not Cool

Editor, RADIO NEWS:

——! After suffering every possible and impossible criticism, broadsides from the Navy, gentle pokes à la Dempsey ~~from~~ South, North, East and West, gentle hints to buy a better set, delicate suggestions that I ought to be thankful for living so far from so-called local stations—

Now, folks! Let's see what we have here. In the first place, I have a four-tube "Dyadyne," sensitive, "detective" enough to get New York and the Pacific coast and Canadian stations, with volume enough to handle a three-foot cone speaker; selective enough to separate KDKA from KFAB, KMOX from KSL. But what it cannot do is to separate stations when they bombard it from north, east, south and west on the same wavelengths. Imagine a receiver suffering the bombardment of 700 stations.

LOUIS MARQUARDT, *"A Listener,"*
Hague, North Dakota.

Letters from Home Radio Constructors

(*Continued from page 53*)

the tubes in a broadcast receiver mean a good bit in getting distant reception. This may help many a DX listener; but I suppose this letter will end like a good many of the rest, in the waste-basket.

If your set is not working the way it should, don't think it is a "lemon." There is always a cause for lack of selectivity and volume. The first thing to do in a case like this is to take your tubes to a radio dealer and have him test them. Test your "B" batteries; if they test less than 40 volts, it is time to discard them. Test your "A" battery.

After this, I would suggest a 112-type in the last A.F. stage, a 112A-type in the first R.F. stage, and a 200-type as the detector. This combination is advisable, however, only when you are using two "C" batteries and have 135 volts "B" available.

With the above combination I have received, and have verifications from, EAJ22, Salamanca, Spain; OAX, Lima, Peru; 2LO, London, England; 1RO, Rome, Italy; HHK, Haiti; CYJ, CZE, CYB, Mexico City; 6KW, PWX, 7SR, 6LO, 6XJ, Cuba; and several Pacific Coast stations. I have brought in Hawaii, and my log totals 410 stations with this combination.

The antenna is an important factor in DX reception, but its tuning is still more important. If your tuning is broad, a wavetrap will increase your selectivity and also increase the volume on low-wave stations. I have experimented with several types; that I find most effective has an inner coil 2¾ inches in diameter, with 7 turns of No. 22 silk-covered wire (in shunt across the aerial and ground posts on the set) and an outer coil, 3 inches in diameter, with 78 turns of No. 22 silk-covered wire, tuned by a 13-plate condenser of good quality. I am using an ordinary 3-dial, 6-tube factory-made broadcast receiver.

CHAS. J. ANGSTADT,
822 *N. Front St., Reading, Pa.*

BETTER ON SHORT WAVES

Editor, RADIO NEWS:

There appeared in the July, 1927, number of RADIO NEWS, a blueprint and layout for an 18-1,500 meter receiver. I built this set, using the specified parts. It works extremely well on the low wavebands, up to 200 meters. But on the higher waves there is practically no volume at all. This set is a distance-getter on short waves. I have heard 5SW, England, and PCJJ, Holland, several times, also three California stations. The greatest thrill I ever had in reception was when I heard Tomsk, Siberia.

Would amateurs who have constructed this set kindly write and let me know what results they are getting?

EVERETT J. RANKINE,
Port Morien, Cape Breton, N. S., Canada.

HIS FIRST EXPERIENCE

Editor, RADIO NEWS:

I have completed the Peridyne Five from the RADIO NEWS articles. I had a hard time, for it was my first experience in building a set. I certainly appreciate the result, for the set is working wonderfully. On Friday, April 6, I tuned in three stations from California and two from Mexico. I will close with "Best of Luck."

LOUIS LIMPENS,
177 *W. Amesbury St., Philadelphia, Pa.*

Editor, RADIO NEWS:

I wish to congratulate you on your new hook-up, the Peridyne. I have built one of them and find it most satisfactory. It is very selective, has plenty of volume, and is great for DX. I enclose a log I made out on Jan. 2, which may be of interest to you.

In addition to the stations listed on the log below, I have reached to PWX, Havana, Cuba, nearly every night.

	Wavelength, Meters	*Dial Reading*	*Time, P. M.*
KWK, St. Louis (local)....	234	30	7:00
KFKB, Milford, Kans.....	241	33	7:05
KTNT, Muscatine, Iowa..	256	39	7:15
WBT, Charlotte, N. C.....	258	41	7:25
WPG, Atlantic City, N. J.	272	46	7:40
KMOX, St. Louis (local)	300	54	7:45
KFAB, Lincoln, Neb.....	309	61	8:05
KOA, Denver, Col.....	326	63	8:10
WSM, Nashville, Tenn.....	337	66	8:14
WHB, Kansas City.....	341	67	8:20
KVOO, Tulsa, Okla.....	349	70	8:24
WSAI, Cincinnati, Ohio..	361	72½	8:29
WJJD, Mooseheart, Ill.....	366	74	8:31
WOC, Davenport, Iowa....	375	75	8:48
WBBM, Chicago, Ill.....	389	78	8:50
KMA, Shenandoah, Iowa..	394	80	8:53
WCCO, St. Paul, Minn...	405	82	8:57
WGN, Chicago, Ill.....	416	84	9:03
WJZ, New York, N. Y.....	454	89	9:14
KYW, Chicago, Ill.....	526	94	9:30
KSD, St. Louis (local).....	545	100	9:35

I am using home-made R.F. transformers, as I have been unable to locate any manufactured ones in St. Louis. I have, however, written to the Hammarlund Company for a set. This will undoubtedly clear up the trouble of crowding the upper half of the dial, which I am now experiencing.

You will undoubtedly note this from the log. Furthermore, from 450 meters on up, the volume diminishes greatly. How can I improve this? I would appreciate an answer if you can spare the time to answer this, as I can sell a few of these sets, but do not like to do so until I clear the upper end of the dial.

L. R. CARTIER,
405 *Second Street, O'Fallon, Illinois.*

(*The crowding described is due either to a low maximum capacity of the tuning condensers used, or to a spacing of the turns of wire on the coils greater than that on those used originally, in all probability. When the spacing is too great, the inductance is reduced, and therefore the readings on the dial are altered. Factory-made coils are machine-wound, and therefore uniform. When these coils are made at home, a thread slightly smaller than the wire should be used for spacing turns. See* RADIO NEWS *for December, 1927, for constructional details of the Peridyne Five.*—EDITOR.)

UTOPIAN RESULTS ON FOUR TUBES

Editor, RADIO NEWS:

Having for over two years been an ardent admirer of Messrs. Browning and Drake's idea of building an efficient receiver utilizing only two tubes in the business end of the set, I have often wondered why your magazine and others have failed to give more space to it than it has had. (*This letter was written before the announcement of* RADIO NEWS' *new policy.*—EDITOR.)

I have a home-built set of this type that has anything in this section skinned a city block, regardless of whether it be a T.R.F., Neutrodyne or what-not. I have verification cards from KVOO, nearly six hundred miles north, for daylight reception (noon) and I hear them any time of the

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every month for the beginner, the layman and those who like radio from the non-technical side.

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ANTENNA SLEET REMOVER
A NEW ELECTRIC SET
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Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes. Tuning range below 200 to above 550 meters.

This kit will make any circuit better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency.

Code No. U- 16 (for .0005 Cond.)..... **$15.00**
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AERO Seven Tuned Radio Frequency Kit

Especially designed for the Aero 7. Kit consists of 3 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95 per cent air di-electric. Tuning range from below 200 to above 500 meters. Adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes.

Code No. U- 12 (for .0005 Cond.)..... **$12.00**
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NOTE—All AERO Universal Kits for use in tuned radio frequency circuits have packed in each coil with a fixed primary a twice matched calibration slip showing reading of each fixed primary AERO Universal Coil at 250 and 500 meters; all having an accurate and similar calibration. Be sure to keep these slips. They're valuable if you decide to add another R. F. Stage to your set.

A NEW SERVICE

We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits, drilled and engraved on Westinghouse Micarta. Detailed blueprints for both battery and A. C. operation and wiring diagram for each circuit included with every foundation unit free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

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1772 Wilson Ave. Chicago, Ill.

$1.00 WILL SAVE YOUR SPEAKER

The Craftsman Dollar Speaker Filter is Guaranteed to relieve your speaker of the DC plate current (up to 250 volts). It gives speaker a chance to operate at its best. Attached in a second. Send dollar bill NOW!

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By-pass and Filter Condensers in all required MFD capacities and working voltages. Filter Condensers supplied in individual units or in completely wired and housed blocks for the more important power amplifiers. Made by The ACME WIRE CO., New Haven, Conn.

Manufacturers of Acme Celatsite Wire—high insulation value, non-inflammable.

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A year's subscription to these two popular magazines for the price of Radio News—alone. If you were to buy Radio News and Radio Listeners' Guide and Call Book individually for one year they would cost you $5.00. By our special combination yearly subscription rate you can get both of these foremost radio periodicals at the tremendous bargain price of $3.00. In order to keep up with the latest developments of Radio, to know the newest sets and how to build them, to find every radio broadcasting station you must read these leading periodicals of radio.

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For the Radio Listeners' Guide and Call Book and Radio News

EXPERIMENTER PUBLISHING COMPANY
230 5th AVE., NEW YORK CITY, N. Y.

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230 5th AVE., NEW YORK, N. Y.

Gentlemen:—Enclosed find $3.00 for which please send me the RADIO LISTENERS' GUIDE and CALL BOOK, and RADIO NEWS for one year beginning with the next issue. It is understood there will be no further payments of any kind.

Name .....

Address .....

City .....

State .....

day they are on, while the best distance in daylight brought a nice letter from WFIW at Hopkinsville, Kentucky, confirming hearing their noon program.

I am using plate detection instead of the leak and condenser as recommended for the UX 200A; my first reason being for tone quality, and my second being that I get more *controllable* sensitivity, as the tube can be brought up to the very verge of oscillation by proper handling of the feedback condenser without suddenly plopping over. In spite of numerous statements to the contrary in your magazine, I find plate detection more sensitive; in my set, in particular, this is true as I have things so arranged that in three seconds or about it is possible to change from one to the other type.

The range at night seems to be limited only by moanings and heterodyning of 700 stations where but 200 should be heard. WEAF would be available if the station interfering with it and producing the loveliest contralto effect would be silent. Man, oh, man, if I only had for one week the authority of the Radio Commission! What a difference there would be.

Give Mr. Browning and Mr. Drake a hand once in a while; it's due them.

GUY STEWART,
Utopia, Texas.

ANOTHER PERIDYNE BOOSTER

Editor, RADIO NEWS:

It gives me great pleasure to tell you of the wonderful results I have obtained from the Peridyne Five, which I constructed according to your detailed instructions in the December, 1927, issue of RADIO NEWS.

The volume and the tone of the set are wonderful; in fact the volume is so great on locals that I had to put in an interstage jack and use only one audio transformer for local reception. I substituted a few of the parts, using Pilot condensers, Filkostat filament controls and Karas Harmonik transformers. I wound my own coils on 2-inch bakelite forms, and used the specified Peridyne shields.

I have built a number of the other sets designed by you, such as the Balanced Interflex Four and the regenerative Interflex. At present I have an Interflex Four and think a great deal of it.

Some of the stations picked up by my Peridyne are as follows: WGY, Schenectady; 3XN, Whippany, N. J.; WGN, Chicago; WHAM, Rochester; WAAF, Chicago; KWKH, Shreveport; CJCA, Edmonton; CJCJ, Calgary; KFI, Los Angeles; KHJ, Los Angeles; KGO and KLX, Oakland; KFRC, San Francisco; KGW, Portland, Ore.; KHQ, KGA, Spokane; KFSD, San Diego; KOA, Denver; CKWX, CNRV, CFCQ and CKCD, all of Vancouver, B. C.; KMO and KVI, Tacoma; and KFAU, Boise, Idaho. I think this is a pretty good list for two nights running, don't you?

I will gladly recommend the Peridyne to any set builder who desires to construct a really high-class receiver. Thanking you for this wonderful hook-up.

ARCHIE R. SULLIVAN,
4009 *First Ave., N. W., Seattle, Wash.*

CORRESPONDENTS WANTED

Editor, RADIO NEWS:

For many months I have been an interested reader of your splendid magazine, and have especially enjoyed "THE LISTENER SPEAKS" page.

I have been confined to a wheel-chair for over nine years, and, as my condition is permanent, that is where I will be compelled to spend the rest of my life. I have a five-tube Freshman and you can imagine the joy and entertainment it affords me.

I have lately become interested in amateur radio and would like very much to hear from some of the "Hams" who can give me some dope on how to go about learning the code, passing the examinations, building a small transmitter, etc. Will be extremely grateful if you can find room for this and hope it will catch the eyes of some accommodating amateurs.

I will try to acknowledge each and every letter received.

CHARLEY R. ESTES,
225 *So. Jackson St., Brunswick, Missouri.*

Editor, RADIO NEWS:

I have a three-tube set, detector and two stages of amplification, and I can get the Pacific Coast almost any night on the loud speaker. I have dedicated twenty-five square feet of my room for cards and verifications from various stations. I will not describe my hook-up here, except to say that it is not a reflex. I will be glad to exchange information with anyone else who has a DX hookup; and will answer every letter received. (*A large contract.*—EDITOR.)

WRAY GILLETTE,
Box 63, Lemon City Station, Miami, Florida.

Editor, RADIO NEWS:

I am interested in super-regeneration, and would like to exchange notes with other experimenters on this subject. I have a good deal of information I could exchange for some of their ideas and hook-ups.

LEO KAHN,
7 Westminster Road, Roxbury, Mass.

I should be glad to communicate with fans interested in daylight DX and hook-ups.

EDWIN GILBERTS,
40 *Ninth Ave., Fond du Lac, Wis.*

Would like to hear from all the short-wave fans and exchange ideas concerning antennas for short-wave work.

FRED M. HELLMER,
6211 *Toledo Ave., Detroit, Mich.*

(*Continued on page* 95)

On the Short Waves

(*Continued from page* 60)

heard them on Friday evening. I find that proper 'B' voltage on the detector tube is essential, especially when receiving broadcast signals. If you find the set will not oscillate on the band between 16 and 30 meters, use about 67 volts of 'B' battery."

WHAT STATIONS ARE THESE?

Perhaps some of our readers can help this listener out with the desired information. Wray Gillette, Miami, Florida, writes as follows: "Can you please help me to identify a station heard on a wavelength of 44 meters on March 28th. The announcer would say 'Asto, Asto, Asto, Asto,' every time he announced, repeating the word four times. This was done at the beginning of every announcement. I listened to him for some time and he never spoke a word of English. We had a lightning storm that evening and, just as soon as it was over, I hooked up my set and at once heard a foreign station on 31 meters, two points above 2XAF. Have you any idea who this was? No English was spoken by the announcer."

Walter E. Hedman, Jemtland, Maine, has constructed the short-wave receiving set described in the April issue of RADIO NEWS with the following results: "Having built the receiver and spent about a week with it without getting anything but KDKA and WGY, I was about ready to give up last night when, all at once, I heard someone talking in a foreign tongue. After listening to him for a few minutes I heard him announce that it was the Philips radio station, PCJJ, Eindhoven, Holland, operating on a wavelength of 30.2 meters. I kept him tuned-in on the loud speaker for more than an hour. I also heard him say 'Hello' to several South American stations. I have written them for verification on the above. My aerial is only 50 feet of wire strung under the ceiling of our porch on the west side of the house, using no ground."

Information on the identity of a foreign station is also desired by Robert M. Sprague of Hanover, New Hampshire, who writes concerning a program received on approximately 28 meters. "I wish to ask for any information you may have on a short-wave station received from 8 to 9 P. M., (E.S.T.), on April 12th. All announcements were made in Spanish and began with 'Hello Cuba, Hello Habana,' and ended with 'un momento.' Several times reference was made to the 'Philips Laboratories, Columbia.' Many Victor reproductions were recognized during this program. The modulation was quite good and the station was received with fair volume and slight periodic fading, but always loud enough so that an English announcement could have been understood."

Ferris W. Fitzpatrick of St. Johns, Mich., reports the following short-wave reception: "Nearly every morning I hear a station on about 25 on my dial say "Hello Bostol" repeatedly. Only once or twice have I heard any English and then I only caught the words "We are very interested" and "short-wave." I am quite sure this was the Java short-wave station. I also heard music. Two other stations have been heard on 5 and 17 on the dial. Could you tell me what stations these were, as I am using the RADIO NEWS short-wave set? 2XAD comes in at 59 and about as near as I can figure it out 17.4 meters should come in at 25 on the dial. I hear Big Ben in London on the average of five nights a week at 7 P. M."

Another

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R. TAYLOR

Radio News Laboratories

(*Continued from page 58*)

a range of 2 to 2.8 volts. This tube may be used very successfully either as a detector or as a radio or audio amplifier. It requires 45 volts on the plate as a detector, and a voltage up to 180 as an amplifier. Its dynamic characteristics vary with the filament and plate voltages. With a normal filament voltage of 2.5, the characteristics are as follows:

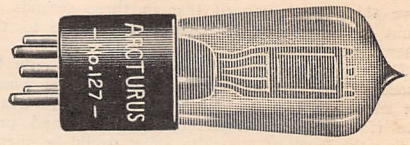


	Plate Voltage 45	90	130
Amplification constant (mu).....	9.9	10.4	10.6
Plate impedance (ohms).....	7200	5700	4900
Mutual conductance (mhos).....	1400	1800	2140

A very important feature of this tube is that its time-lag is very small; unlike the indirect-heated tubes of other types, it takes very little time (a few seconds) to be brought into full operation.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2356.

R.F. CHOKE COILS

The choke coil (type C-248) submitted by Aero Products, Inc., Chicago, Illinois, is similar in construction to their type C-60 described under Certificate No. 2350 (see illustration) but of smaller inductance and resistance value (0.9-millihenry and 4 ohms), and is designed to be employed in circuits operating on very short wavelengths.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2358.

R.F. CHOKE COIL

The choke coil (type No. SM-275 shown) submitted by Silver-Marshall, Inc., Chicago, Ill., has an approximate inductance value of 2½ millihenries, and is designed for use in R.F. circuits operating on wavelengths up to 600 meters. Its D.C. resistance value is approximately 25 ohms. It is compact, and enclosed in a bakelite casing 1¼ inches high and 1⅛ inches in diameter, which is of the one-hole mounting type.

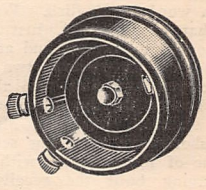
AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2359.

The choke coil (SM-276) submitted by the same company, is similar in construction to the type 275 shown above, but is intended for use on wavelengths above 600 meters. It has an inductance value of approximately 10 millihenries, and a D.C. resistance of 117 ohms.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2360.

RHEOSTAT

The "tapered" rheostat shown, submitted by the Carter Radio Company, Chicago, Illinois, is of the one-hole mounting type and has a molded bakelite frame 1¾ inches in diameter. The interesting feature of this rheostat is that it is equipped with a tapered resistance strip which gives the "characteristic line" (representing the variation of the resistance with the rotation of the knob) the shape of a parabola, instead of a straight line, as with ordinary resistance strips. This type of rheostat is



very convenient in circuits where the useful range of adjustment is limited to a small part of the rotation of the knob. To exaggerate the curvature of the characteristic line, the spacing of the winding is gradually increased at the narrow part of the strip.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2361.

I Want To Know

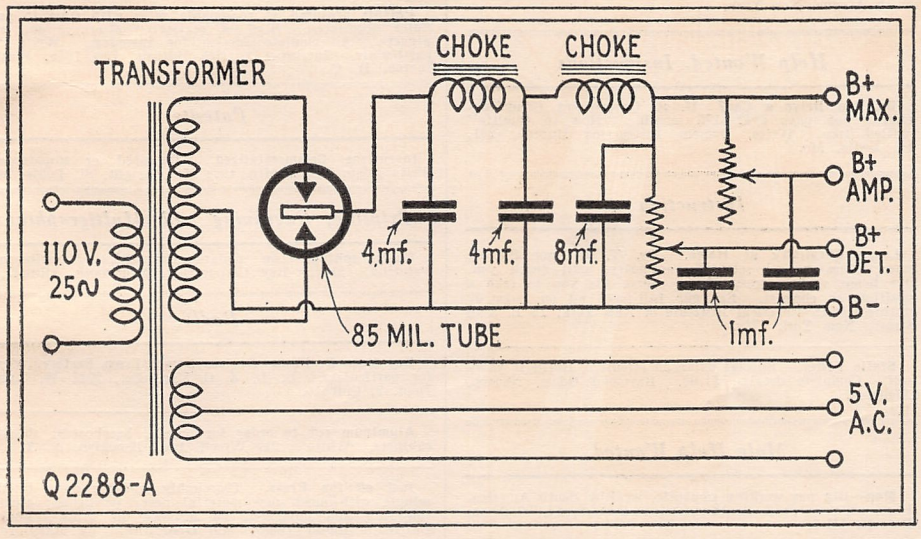
(*Continued from page 57*)

long sections of the core, while the secondary windings are placed on the other long section. The coils should be wound over fiber forms two inches square, so that the form will fit over the core. The primary coil consists of 600 turns of No. 26 enameled wire, and should be wound layer-fashion with thin "fish" paper (a thin, tough, insulating paper) over each layer. Fifty turns of wire should be placed in each layer, making a total of 12 layers. After the coil has been completed, it should be carefully taped with friction tape in order to prevent moisture from entering the winding.

The secondary consists of a center-tapped winding supplying a total of 440 volts, with 220 volts wire should be soldered to each of the wires. After the two coils have been completed, the core should be assembled. The "L" shaped pieces should be butted together from opposite sides, so that they overlap as shown in the assembled core at Fig. Q. 2288B, reversing the arrangement of the pairs in alternate layers. When this method is used, the complete core is solid without much binding, and it is a very simple matter to construct two clamps to bind the laminations tightly in place.

The Choke Coils

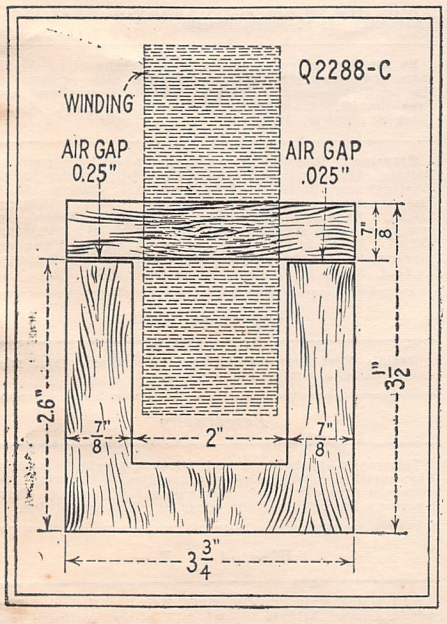
The two choke coils are identical in construction, each being wound with 6500 turns of No. 28 D.C.C. wire, on a core of the dimensions shown in Fig.



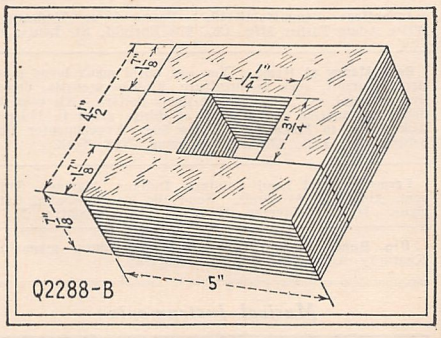
Specifications of a 25-cycle "B" power unit, suitable for use with a 112- or 171-type power tube. Large chokes and condensers are required to smooth out rectified A.C. of such low frequency.

on each side of the center tap. The complete coil contains 2,400 turns of No. 30 enameled wire, with a tap at the 1,200th turn. This coil should be wound similar to the primary, with 100 turns on each layer; making a total of 24 layers. The fish paper should be used also between the layers of this coil. When the winding is complete, several layers of fish paper should be placed over it; and over this coil is placed the filament winding for the power tube, which consists of 28 turns of No. 18 enameled wire with a tap at the 14th turn.

Each of the wires should be brought out through insulating tubing, or a section of insulated flexible



Specifications for a 20-henry choke coil, such as are required in the 25-cycle power unit. The air gap is vitally important.



The core of the power transformer is built up, as shown, of silicon-steel strips; each alternate layer being reversed to bind it together.

Q. 2288C. An air-gap of .025-inch is provided, on each side of the core, to prevent saturation and consequent lowering of the inductance. The direct-current resistance of each of these chokes is about 100 ohms, and the inductance is about 20 henries, under the conditions in which they are to be used.

The laminations of these chokes are also cut from silicon steel .014-inch thick, and each piece is shellacked in the manner described above for the transformer. These pieces are cut "U"-shaped and straight, for the outer and inner parts of the core. In this case, the various laminations are placed one directly over the other, and no staggering is used. The straight pieces can be assembled and the windings placed directly over this part of the core without the use of a fiber spool or other means of support. Several layers of insulating cloth should be wound over the core, and the winding placed directly over this core. Two fiber washers should be provided, to complete the spool for winding the coils; these should be about 3½ inches in diameter, with a hole ⅞-inch square cut in the center. A wooden clamping arrangement should be provided for these coils, so that the air-gap can be adjusted and fixed. Straight wooden pieces with bolts may be used to hold the laminations tightly in place and, by

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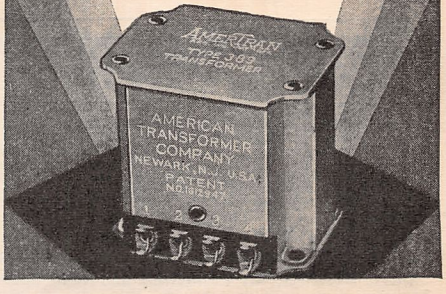

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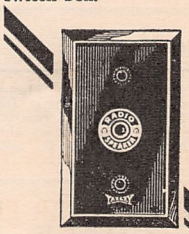

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Patents—Send drawing or model of your invention for examination and instructions. Advice and booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 9th Street, N.W., Washington, D. C.

Patent Attorneys (Continued)

Patent Sense—Valuable book free. See Laccy's ad, page 71. Lacey & Lacey, 631 F. St., Washington, D. C. Established 1869.

Patents procured at reasonable rates **with time to pay.** Sales negotiated. Staff of registered attorneys and engineers. A complete service for inventors. **Write for** particulars. Inventors Service Bureau, Box 1648, Washington, D. C.

Patents

Inventions Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 278 Enright, St. Louis, Mo.

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Radio

Buy Your B. Power Devices Direct From Factory. Send for particulars. D. L. & G Mfg. Co., 2941 W. Lake, Dept. 9, Chicago.

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Just off the Press. Thoroughly revised; down to the minute with much new material never published; greatly improved and enlarged; no advance in price. Fourth Edition, "Radio Theory and Operating," by Mary Texanna Loomis, President, Loomis Radio College; Member, Institute of Radio Engineers. Nearly 900 pages. Over 700 illustrations, beautifully bound in flexible red craft leather. Stamped in gold. Complete text and reference book on radio; special chapter on "Aircraft Radio;" much European material added, especially British. Ever since publication of first edition in 1925 this book has been used as a text by practically all the leading radio schools in the United States and Canada, also many universities, technical colleges and high schools, and all Government radio schools. Recognized as America's standard radio text book. Contains wealth of practical and systematically arranged information. Different from other works on the subject; is understandable and interesting; not just page after page or dry theory. Fills a long felt want in the line of radio text and reference books. Is a library in itself and you should have a copy, if interested in radio. For sale at nearly all bookstores in United States, also in Shanghai, China; London, England; Melbourne, Australia; Wellington, New Zealand; Calcutta, India; Honolulu, T. H.; Manila, P. I.; Vancouver, B. C. Price $3.50. Buy of your bookdealer, or send check or money order for prompt delivery to Loomis Publishing Company, Dept. 7, Washington, D. C.

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Full Value Paid for Old Gold, Jewelry, Watches, Diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore; magneto points, old false teeth. Packages returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable), 39 So. State St., Dept. 16, Chicago, Ill.

releasing the bolts, the distance between the two sections of the core can be varied.

Assembly of the Unit

After the transformer and the two chokes have been constructed, the unit can be completed. The other apparatus needed for this unit is as follows:

One 85-milliampere gaseous-conduction rectifier tube and
One vacuum-tube socket;
Two 4-mf. filter condensers, 400-volt rating;
One 8-mf. filter condenser, 400-volt rating;
Two 1-mf. filter condensers, 200-volt rating;
Two 0-to-500,000-ohm variable resistors;
One baseboard, 10x12x½ inches;
Seven binding posts;
One insulating strip, 10x2x3-16 inches;
Wire, plugs, etc., etc.

The apparatus should be laid out with the transformer at one end, and the filter condensers and choke coils so spaced that the wiring will be as short as possible. The resistors and binding posts can be mounted on an insulating strip fastened to one end of the baseboard. If it is so desired, the complete unit can be enclosed in a metal case, with the binding posts and control panel at the front. If this is done, it will be possible to ground the metal case; this will serve to prevent any interaction between the power unit and receiver which might introduce a humming noise. The core of the transformer may also be grounded to the metal case and this will tend to increase the stability of the unit's operation.

SCREEN-GRID CHARACTERISTICS

(2289). Mr. J. M. Kruger, San Francisco, Calif., writes:

(Q.) "Will you publish the operating characteristics of the new screen-grid tube? This should be of interest to a number of radio fans, since this tube is becoming so popular."

(A.) We are printing the data supplied by the Radio Corporation of America for use with the new screen-grid tube, UX 222.

It is designed primarily as a "screen-grid" tube, for use as a radio-frequency amplifier in circuits especially designed to make use of its high amplification and low feed-back capacity between plate and control grid. When used for this purpose, it is not interchangeable with the ordinary three-element tubes, and *cannot be used to replace them in standard sets.* This tube may also be used as a "space-charge grid" tube; its extra element being then operated at a positive potential to increase the mutual conductance of the tube. It is useful also for other experimental purposes where a double-grid, four-element tube is required.

Tube Must Be Shielded

The tube is provided with the standard UX base and an extra contact at the top of the glass bulb. When mounted in a vertical position, the tube should be shielded by a metal jacket fitting closely over the bulb, but having at the top an aperture, with insulated circumference, and which insures clearance (not exceeding 1-16-inch) between the metal of the jacket and the metal cap. The jacket should extend down at least to the base, and should be connected to either filament terminal of the socket.

When the tube is used in conjunction with storage-battery tubes having five-volt filaments, a tapped 15-ohm resistor should be placed in series with the negative lead of the screen-grid tube. In this way, the tube can be operated from the six-volt supply for the storage battery tubes.

When used as a screen-grid radio-frequency amplifier, the 222 tube is designed to operate under the following normal conditions.

Element	Supply	Voltage
Plate	"B"	+90-135
Screen-(Outer) Grid	"B"	+45
*Control-(Inner) Grid	"C"	—1-1.5
Filament	"A"	+3.3

*This bias may be obtained from a resistor in the "A—" return.

The control-grid biasing voltage is given with respect to *the negative side of the filament.* Neither the plate nor the screen-grid voltage is critical. The same battery can be used for both, by using a tap on the battery. The control-grid bias can be obtained from a separate dry cell, or may be obtained automatically when the tube is used with a 6-volt supply. This bias is obtained by tapping the 15-ohm series resistor at the correct point. In using this tube, it is necessary to shield the control-grid circuit, including the wiring, coils and condensers. A grounded metal case should be used for this purpose.

As a Space-Charge-Grid Tube

The 222 tube may be used in circuits requiring a tube with a high amplification factor and high mutual conductance, such as resistance-, reactance- or transformer-coupled amplifier circuits. For this connection, the inner grid is used as a space-charge grid at a potential positive with respect to the filament. The normal operating conditions are:

Element	Supply	Voltage
Plate	"B"	+135-180
Control-(Outer) Grid	*	—0-1½
Space-Charge (Inner) Grid	"B"	+22½
Filament	"A"	+3.3

*The negative bias is obtained through a resistor or potentiometer.

The plate-supply voltage is not applied directly to the plate in this case, but to the plate-coupling resistor of 100,000 to 250,000 ohms.

THE "THERMIODYNE" RECEIVER

((2290). Mr. A. N. King, Trenton, N. J., writes:

(Q.) "I would like to obtain the diagram of the 'Thermiodyne TF6' receiver. I have one of these receivers which is not working correctly, and I would like to check the wiring if possible."

(A.) We are printing the diagram of this receiver in this issue; see Fig. Q. 2290. Unfortunately, *none of the constructional details or values of the parts employed in this set are available,* as its manufacturers are out of the business; but we trust that the diagram may be of assistance to you in the matter of locating the trouble in your set.

Letters from Radio Constructors

(*Continued from page* 91)

I would like to exchange letters with other builders of broadcast and short-wave sets, especially those who wind their own coils.

WALTER HAWKINS,
Box 50, *R. R. No.* 1, *Wakarusa, Ind.*

"I would feel greatly indebted," writes Arthur Ludovichetti, of Villa Anita, Rimini, Italy, "if you could put me in communication with some young fellows to exchange ideas."

I wish you could give me the full address of Mr. J. C. Scott, of Plainfield, N. J., as I like to correspond with radio friends if I can. I have letters coming from both coasts each week and it is indeed very interesting to read them, as you get very interesting points of view.

"DUCK" BETTELON,
R. R. 1, *Centerville, Ohio.*

JUNIOR SET BUILDERS

Editor, RADIO NEWS:

I am a boy fourteen years of age, and have read your magazine for two years and must say I get much help from it. Recently I built a two-tube set, using the old Armstrong hook-up. This puts me right in the DX class and I challenge any boy my age to construct a two-tube set, any hook-up, that will equal mine. I have picked up stations in thirteen different states: WGY, WHAM, WCCO, WGN, WBBM, WLIB, and WSUI, I use the loud speaker on the Pacific coast stations and on many Texas stations. I use an aerial 118 feet long and thirty feet high. I have UX-199s in my set at present and they are very satisfactory. Together, the set has proved quite a success. Remember my challenge!

NATHANIEL MCKELVEY,
604 *East First St., Tucson, Arizona.*

I would like to correspond with fellow experimenters 14 to 15 years of age. I am interested in one, two, three and five-tube sets and will exchange notes with any boys out in the West or in foreign countries.

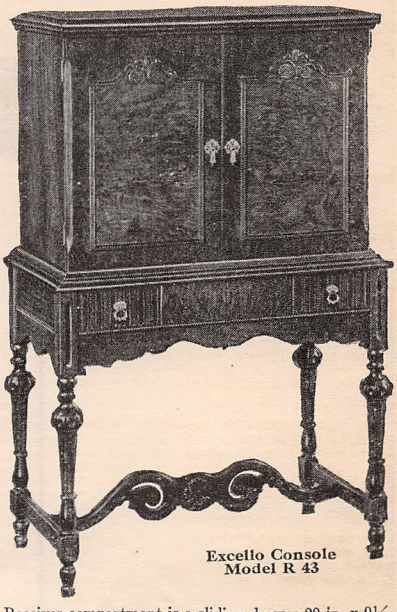
LEO AUGUST,
510 *So. 18th St., Newark, N. J.*

HIGH POWER IN JAPAN

Reception of Japanese stations in the United States, Canada, South America and Australia, etc., should be greatly facilitated by the great increase in power of the leading stations. JOAK, Tokio, (345 meters) and JOBK, Osaka, (400 meters) have been increased to 10 kilowatts; and four more stations of equal power were recently completed. They will take the following wavelengths: JOFK, Hiroshima, 353 meters; JOGK, Kumamoto, 380 meters; JOHK, Sendai, 390 meters; JOIK, Sapporo, 361 meters. JOCK, Nagoya (360 meters), and JODK, Keijo, 345 meters, remain at 1 kilowatt, as before.—*S. Handa.*

EXCELLO
Radio Consoles

A new console designed for
RADIOLA MODEL 18
or other receivers, either A.C. or D.C.



Excello Console
Model R 43

Receiver compartment is a sliding drawer 29 in. x 9½ in. x 12 in. deep. Ample room in speaker compartment for cone speaker and eliminator. Cabinet, walnut throughout, with fancy butt walnut veneer doors.

At your Dealers, or write for complete catalog of full line.

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Sizes range from 7x18x10 to 7x30x12. Mahogany finish, $5.50 to $8.75. Solid Walnut, $6.50 to $10.25. F.O.B. Hickory. Twelve-hour service. Write for Catalog.
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NEW IMPROVEMENTS

THE UNIVERSAL TRANSOCEANIC has now been completely redesigned to use the new 222 Screened Grid Tubes in the four stages of radio frequency amplification. The total radio frequency amplification is now approximately 810,000, compared with only 10,000 obtained with the 201A tubes. This allows increased receiving range, greater volume on distant signals and without any loss in selectivity. The detector circuit has been altered to use the new 200A type detector.

The audio amplifier has been further improved, a total of four stages being employed, two of these stages in a push-pull system. The push-pull power amplifier will take either two 210 or two 250 power tubes, the most powerful audio amplifier one could desire. The undistorted output available for the loud speaker is approximately five times greater than a receiver using only one 210 or 250 power tube.

The 400/500 Volt BC Current Supply has been changed to the full wave type, using two 281 rectifier tubes for increased output. Provision has been made to use a Dynamic speaker if desired. The addition of the Leutz "A" current supply, having a capacity of 3 amperes at 6 volts, makes the set available for all electric operation.

Present owners of Transoceanics can have the above improvements added to their receivers at a nominal cost, sending the receiver to our factory.

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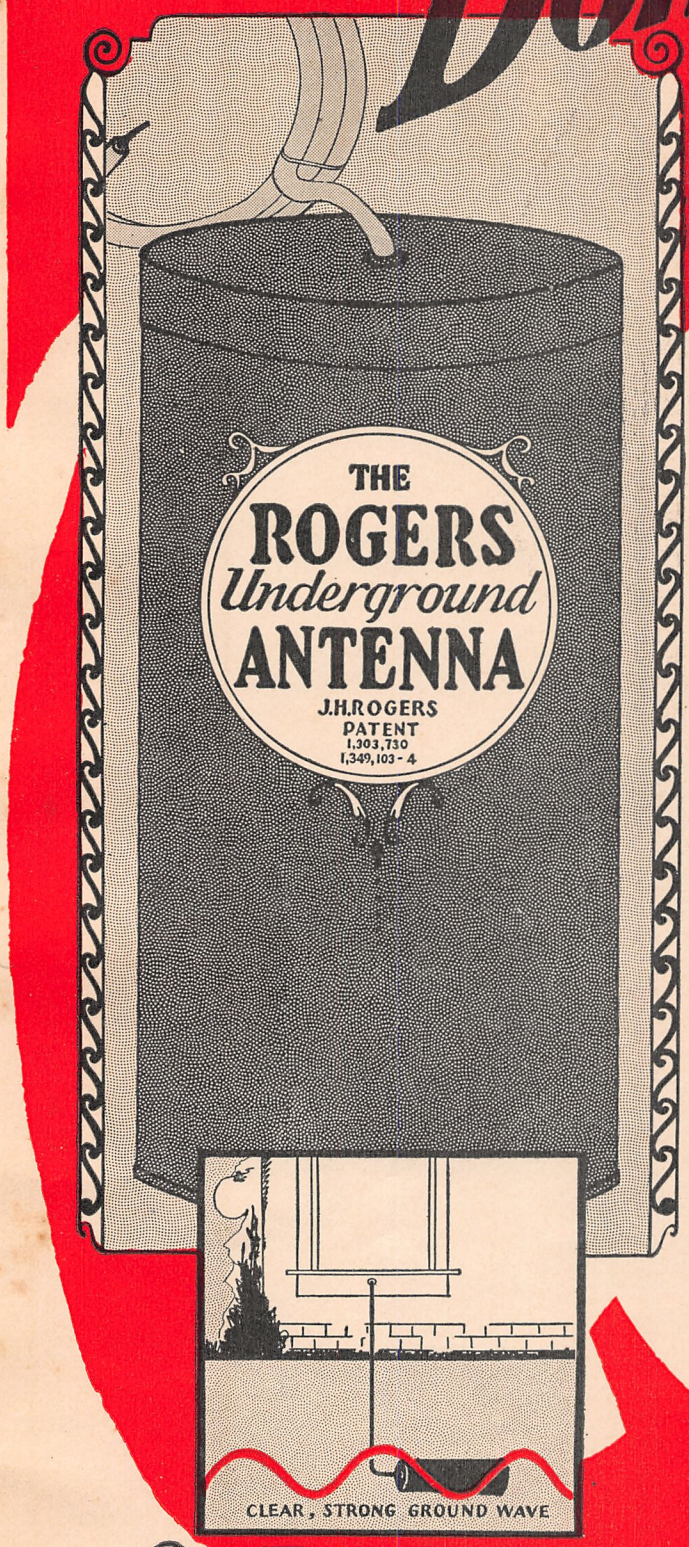

Get Clear, Loud Distance *Any time of year!*

Summer, Fall, Winter or Spring—lightning storm, summer heat, or blizzard—it makes little difference; distant stations come in loud and clear, and unspoiled by static when taken out of the ground with a Rogers Underground Antenna. In all truth, this amazing new device is one of today's greatest forward steps in the perfection of Radio. It *actually* and positively enables you to *dominate* Static.

The Perfected Invention of DR. J. HARRIS ROGERS

Dr. Rogers is known the world over for his sensational work of private and governmental nature, in the transmission and reception of ground waves. The Rogers Underground Antenna has been perfected for home use and is manufactured and sold under Dr. Rogers' patents.

Read the Amazing Facts

When static is present in the air, its strength is frequently greater than the strength of the desired radio signal. Hence, in the air, your reception is dominated by the noise level. In the ground, as Dr. Rogers proved, and as you can prove, there is a lesser amount of static. And when there *is* static in the ground, it is never equal in strength, to the strength of the desired Radio signal. Therefore, when you use the Rogers Underground Antenna you actually reverse the static-signal ratio; you actually dominate static; you positively bring the distant stations in so loud and so clear that what little static there might be in the ground is barely heard, if at all. You'll be amazed when you compare reception obtained with a Rogers Underground Antenna to the reception you have been accustomed to.

TRY IT ON YOUR SET FREE

It costs you nothing to test the Rogers Underground Antenna excepting the five minutes time it takes to install it. Just five minutes of your time—that's all you'll be out, if you're not more than pleased. We don't ask you to pay a cent for the Rogers Underground Antenna if you don't find, after exhaustive test on your own set, that this great radio improvement is all we claim for it, and all Dr. Rogers proved it to be when he obtained his patents. Send the coupon now. Let us send you ALL the startling facts and full particulars of the FREE comparative test we want you to make. Clip the coupon. Send it today.

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The ROGERS Underground ANTENNA

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Send me *all* the facts on the Rogers Underground Antenna. Also full particulars of FREE Test Offer and GUARANTEE.

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HERE is an opportunity for you to be the first in your neighborhood to banish static and have almost perfect radio reception. Mail this Coupon *right now.*

Abox

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The Ideal Way to convert your present set to an A. C. receiver

No change in tubes or wiring

Licensed by the Andrews-Hammond Corporation, under patent 1,637,795 and applications

New Features—Better Value than ever before

All the features that made Abox the outstanding success of last year are retained in this new model. The improvements are the result of untiring research and the experience gained from many thousands of these devices in actual service.

For convenience, a receptacle for the "B" unit and a control switch is now standard equipment. A new design and attractive finish add to its trim appearance.

Interior changes in construction give assurance of even longer life and better service.

The reliability and efficiency of the standard D. C. tubes need not be sacrificed to enjoy the convenience of true electric operation. Abox changes 110-volt 50 to 60 cycle current to hum-free direct current, thus giving true A. C. operation. No storage battery is used.

The Abox may also be used to supply current for the 6-volt dynamic speaker.

Dealers: Six million radio owners using storage batteries are prospects for Abox. They are thinking about A. C. conversion. Abox is the logical purchase for them. It requires no change in wiring—no external volume controls—no change in tubes. The set retains all its original good qualities plus increased efficiency and the convenience of an electric set. The Abox name and reputation are known to a multitude of set owners.

Do not overlook the opportunity of selling the idea of A. C. conversion to your customers.

The Abox merchandising policy provides for a full measure of protection and co-operation to dealers and jobbers. Write for details.

Visit the Abox booth No. 158 at the R. M. A. Trade Show, June 11-16, Stevens Hotel, Chicago. *See the new Abox and other products.*

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